



US Army Corps
of Engineers

Great Lakes and Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT

Ohio River Mainstem Systems Study (ORMSS)

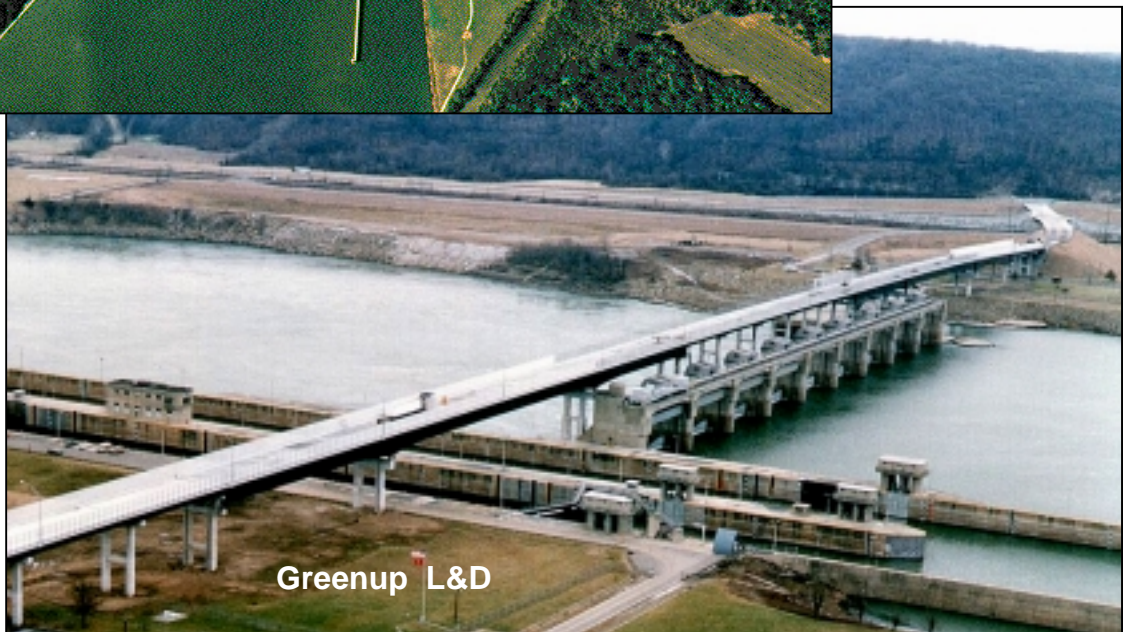
Interim Feasibility Report:

J.T. Myers and Greenup Locks Improvements

INDIANA, KENTUCKY and OHIO

Document MR:

Main Report and
Environmental Impact Statement



April 2000

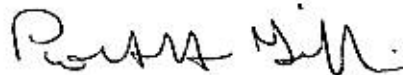
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SUBJECT: Ohio River Mainstem Systems Study (ORMSS), J.T. Myers and
Greenup Locks Improvements Interim Feasibility Report

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I concur in the recommendations of the District Commanders.



Robert H. Griffin
Brigadier General, USA
Commanding



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Interim Feasibility Report:

J.T. Myers and Greenup Locks Improvements

INDIANA, KENTUCKY and OHIO

Document MR:

Main Report

(FINAL Environmental Impact Statement attached)

April 2000

SYLLABUS

(EXECUTIVE SUMMARY)

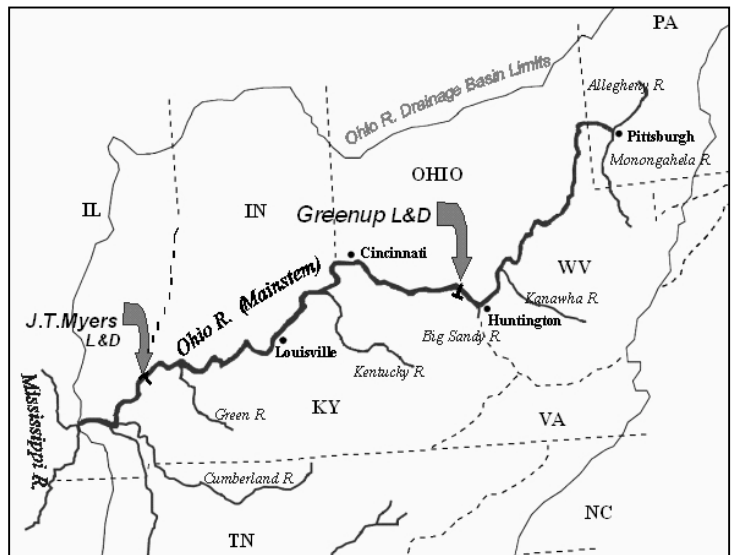
This Interim Feasibility Report is the first recommendation document issued as part of the ongoing Ohio River Mainstem Systems Study (ORMSS). The Interim Report has been prepared by the Corps of Engineers' Louisville District, working in conjunction with the Corps' Huntington District, technical support from other Corps' offices, and with the assistance of various other state and federal agencies.

The primary purpose of the ORMSS is to identify the best long-term program for maintaining a viable navigation system on the main stem of the Ohio River. Specifically, the study is evaluating the major maintenance, major rehabilitation, and new construction investment needs for the 19 navigation locks and dams on the Ohio River Mainstem – with an aim to identify the most cost-effective plan for meeting these needs over the next 40-50 years. (Currently, there are 20 locks and dams on the Ohio River; after completion of Olmsted L&D circa 2007, there will be 19). These 20 structures are crucial to the orderly development of navigation throughout the entire Ohio River Basin.

This Interim Report will concern itself with the formulation of solutions at the two highest-priority structures needing improvement – namely J.T. Myers L&D and Greenup L&D. The locations of these two projects are spotted on the regional map (below).

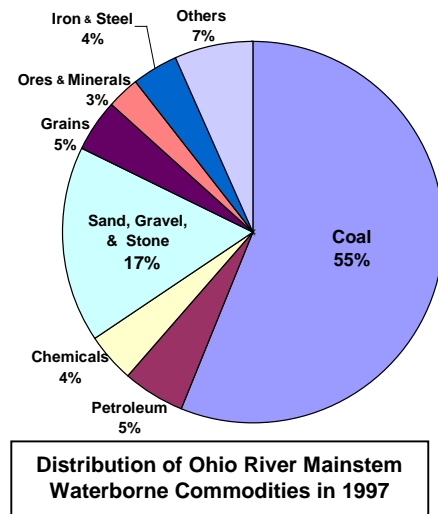
Ohio River Navigation

The Ohio River Basin, that area drained by the Ohio River and its tributaries, is home to 25 million people. Pittsburgh, Cincinnati, Columbus, Indianapolis, Louisville, and Nashville are the region's largest cities. Waterborne commerce is made possible in the basin by a series of 60 lock and dam projects spread throughout the Ohio River and its 12 navigable tributaries. In recent years barges throughout the Ohio River Basin have carried approximately 260 million tons of commodities on navigable rivers. These commodities are the products of coal mines, petroleum refineries, stone quarries, cement plants, and farms and the raw material for construction companies, steel mills, electric utilities, paper plants, aluminum manufacturers, and chemical companies.



The mainstem of the Ohio River extends from Pittsburgh, Pennsylvania, to near Cairo, Illinois, where the Ohio joins the Mississippi River -- providing 981 miles of commercially navigable channel. Year-round navigation is provided by a system of 20 locks and dams and annual maintenance dredging of the channels. The current Ohio River improvements generally provide for safe navigation of commercial tows as long as 1200' long x 108' wide (equivalent to 15 jumbo-hopper barges), although even larger tows are occasionally used in some areas.

Ohio River Mainstem traffic is dominated by coal transportation, as shown in the pie-chart (at right). Of all commodities, coal has grown by the greatest amount over the last 10 years, but other commodities have grown at faster rates. Sands/gravel/stone, ores and minerals, and iron and steel products all grew at average annual rates in excess of 4.0 percent annually.



Problems and Needs

The primary problems at Myers and Greenup Locks and Dams involve traffic delays. Myers and Greenup are two of the most heavily used locks on the Ohio River. When the longer 1200' long chamber at either of these facilities is closed due to maintenance or accidents, all traffic must lock through the smaller, land-side 600' long chamber. This results in long delays to commercial tows. Reducing these delays can save millions of dollars in transportation costs, and also reduce the impacts of waiting-tows on aquatic resources in the immediate area of the locks and dams.

As the lock and dam facilities age, more maintenance will be required. Various alternatives have been considered to either minimize maintenance closure time and / or to increase traffic throughput when one or the other chamber is closed to traffic.

Report Conclusions and Recommendations

The J.T. Myers and Greenup Locks Interim Report recommends similar improvements at each of the Myers and Greenup Lock and Dam sites. Improvements recommended include:

- Extending the shorter 600' locks (the land-side chambers) to 1200' length. (These are nominal dimensions, i.e. a 1200'-chamber means that a 1200-foot long tow can be accommodated in the chamber.)
- Installation of a Miter Gate Quick Changeout Systems (MGQCS). The MGQCS provides for significantly faster repairs to the lock gates in the future at these two sites, whenever gate repairs are required.
- At Greenup only, Major Rehabilitation of the lock chambers. Pertinent details regarding the justification of this Rehabilitation are contained in this interim report; therefore, it is concluded that this report concurrently satisfies all reporting requirements for Major Rehabilitation as well as for new work requiring Congressional authorization (the lock extension and installation of the Miter Gate Quick Changeout System).

It is recommended that the above-listed lock extensions and Miter Gate Quick Changeout Systems for Myers and Greenup Locks be authorized for implementation as Federal projects together with such modifications as, at the discretion of the Chief of Engineers, may be advisable. For the Myers project site, first cost of construction is estimated at \$181.7 million, and the improvements yield a benefit / cost ratio of 1.8 to 1. For the Greenup project site, first cost of construction is \$175.5 million, and the improvements yield a benefit/cost ratio of 2.5 to 1. If authorized by Congress, all future design and construction costs would be shared 50/50 between the U.S. Government and the Inland Waterway Users' Trust Fund (this fund is maintained through a waterway diesel fuel tax).

Document MR:
Main Report
(Environmental Impact Statement attached)

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Code

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MR

Main Report and EIS

THIS DOCUMENT

ERD

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EC

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RE

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SECTION 1

STUDY AUTHORITY

The basic authority for the Ohio River Mainstem Study, is contained in the resolution adopted by the Committee on Public Works of the United States Senate dated 16 May 1955:

Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the reports on the Ohio River published in House Document No. 306, Seventy-fourth Congress, First Session, House Committee on Flood Control Document No. 1, Seventy-fifth Congress, First Session, and related reports, with a view to determining whether any modifications in the present comprehensive plan for flood control and other purposes in the Ohio River basin is advisable at this time.

Further authority was provided through a resolution adopted by the U.S. House of Representatives Committee on Public Works and Transportation adopted 11 March 1982. This resolution reads as follows:

Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors established by the Section 3 of the River and Harbor Act approved June 13, 1902, is hereby requested to review the reports on the Ohio River published as House Document No. 492, 60th Congress, First Session, and House Document No. 306, Seventy-fourth Congress, First Session, and other pertinent reports with a view to determine whether any modification in the authorized plan for modern barge navigation and other purposes on the Ohio River is advisable at this time with particular emphasis on need for improvement or replacement of Emsworth Locks and Dam, Ohio River Mile 6.1; Dashields Locks and Dam, Ohio River Mile 13.3; Montgomery Island Locks and Dam, Ohio River Mile 31.7; and other locations where obsolete or inadequate facilities impede the orderly flow of commerce.

SECTION 2

PURPOSE AND SCOPE

The primary purpose of the Ohio River Mainstem Systems Study (ORMSS) is to identify the best long-term program for maintaining a viable navigation system on the main stem of the Ohio River. Specifically, the study is evaluating the Major Maintenance, Major Rehabilitation and New Construction investment needs for the 19 navigation locks and dams on the Ohio River Mainstem – with an aim to identify the optimum plan for meeting these needs over the next 40-50 years. (Currently, there are 20 locks and dams on the Ohio River; after completion of Olmsted L&D circa 2007, there will be 19). These structures are crucial to the orderly development of navigation throughout the Ohio River Basin. As traffic grows through the Ohio River Valley, several lock structures will experience increasing delays. These delays may be particularly severe whenever one of the existing chambers at any one of the facilities must be closed for repairs. Older locks will become increasingly unreliable due to age and cycles of use.

More specifically, the study is considering economic, social, and environmental impacts of both large-scale investments and small-scale navigation improvements. For example, large-scale improvements would involve any of the following:

- the lengthening of existing 600' chambers so as to provide at least two 1200' chambers where justified,
- construction of a third lock chamber at certain Ohio River locks and dams, or
- provision of replacement locks and dams at older facilities (such as Emsworth, Dashields, or Montgomery L&Ds).

Smaller-scale improvements, generally less than \$10 million in capital costs (per site), are also being considered -- some as part of the Without-Project Condition (where authority for construction already exists) and some for With-Project plans. Small-scale concepts include:

- installation of permanent mooring buoys or cells near lock approach points (which could enhance tow mooring in queuing situations and possibly speed up double-cut processing);
- lengthening of guide or guard walls to improve lock approach times;
- provision of spare lock gates, and new maintenance procedures to speed-up lock maintenance, and
- other infrastructure or procedural opportunities.

All of these needs and solutions will be discussed in a final ORMSS report due for completion in another 24-36 months. However, due to pressing needs at J.T.Myers and Greenup Locks, this

Interim Report has been prepared to recommend certain authorizations in advance of the final ORMSS report.

PURPOSE OF THIS INTERIM REPORT

The ORMSS final report, still under development, is intended to be an authorization document for near-term needs (over the next 15-20 years) and a Master Plan for long-term needs. During the course of the study, a clear justification was found for authorization of large-scale improvements at two Ohio River facilities – namely J.T.Myers Locks & Dam (L&D), and Greenup L & D. This Interim Report provides the justification and rationale for proceeding to Congressional authorization for these improvements *at this time* – in advance of the final ORMSS report. It is believed that the findings of this Interim Report are very robust – i.e., it is most unlikely that the recommendations in this report will be contradicted by any findings in the broader final ORMSS report.

In terms of both traffic levels and delays, the two projects which are the focus of this report, J.T.Myers and Greenup Locks & Dams, are the two busiest lock projects on the Ohio River for which major improvements are not *already* underway or authorized. Currently, improvements are already underway (or authorized) at the following sites:

- R.C. Byrd Locks & Dam (formerly Gallipolis L&D) – new lock chambers were completed in 1995. Work is still underway to renovate portions of the dam, so it will continue to function over the next 50 years.
- Olmsted Locks and Dam – now under construction near Olmsted, Illinois – replaces two very old structures, L&D 52 and L&D 53.
- McAlpine Locks and Dam – construction has begun to replace one of the oldest components of the system -- the existing 70-year old landside 600-foot chamber -- with a new 1200-foot lock chamber.

Second only to Smithland L&D, which is located about 80 miles downstream of Myers, Myers L&D is the second busiest lock in the U.S. in terms of traffic volume.¹ See Figure 2-1. However, Smithland L&D has **two** 1200-foot long locks to efficiently process long commercial tows, as will the new Olmsted project now under construction. Myers L&D has only one 1200-foot chamber, which is in use round-the-clock, and a smaller 600-foot auxiliary lock. Both Myers and Smithland are located on the lower end of the Ohio River, between important

¹ Slightly more traffic transits past Locks 52 and Locks 53, which are being replaced by Olmsted. However, the lock chambers themselves at L&Ds 52 and 53 are used less than 60% of the year—since barges can travel over the navigable dam wickets at these two sites during high water periods. Hence, the lock chambers themselves (which tend to be a bottleneck) process a greater volume of traffic at Smithland and Myers Locks.



Figure 2-1. Aerial Photograph of J.T. Myers Locks and Dam.



Figure 2-2. Photograph of Greenup Locks and Dam

navigable tributaries – the Green River (of Kentucky) located upstream of the locks, and the Cumberland and Tennessee River, which enter the Ohio River downstream. Many long-distance shipments moving to (or from) Gulf-coast states (and international shipments passing through the ports of New Orleans or Mobile) use J.T.Myers Locks.

Greenup is the third busiest lock in the U.S. in terms of traffic volume. It is located on the Ohio downstream of the mouths of the Kanawha and Big Sandy Rivers. See Figure 2-2. The Kanawha and Big Sandy Rivers provide waterway access to high quality coal reserves in West Virginia and Kentucky. A significant amount of coal passes through Greenup Locks on its way to downstream powerplants in Kentucky, Ohio, and Indiana. Traffic at Greenup has grown faster this decade than at any other Ohio River Project. Like Myers L&D, Greenup has one 1200'-long lock chamber, and a smaller 600' auxiliary lock.

SCOPE

Improvements considered in this Interim Report are limited to U.S. government property at two lock sites -- J.T.Myers L&D (just downstream of Mount Vernon and Evansville, IN), and Greenup L&D (near Greenup, KY – just downstream of Ashland, KY, and near Portsmouth, OH). Improvements considered in this report may also include the river itself and possibly adjacent shorelands within a mile or so immediately upstream and downstream of both locks – as might be required either for improved navigation through these locks, disposal of excavated materials, or for temporary construction work areas.

Impact evaluations for the Interim report and in the Interim Environmental Impact Statement (EIS), include impacts to traffic, employment, fish and wildlife, commerce and other factors. As a result, certain impacts are discussed both in the immediate vicinity of the two U.S. Government lock sites, and also along larger portions of the Ohio River system -- to the extent that such specific impacts are measurable over a wider regional area.

PLANNING CONSTRAINTS

The following represents three constraints or assumptions that have, in a sense, limited the range of options explored in this study. The first of these were implicit from the earliest stages of the Mainstem study.

Constraint 1: No Change To Authorized Nine-Foot Draft Ohio River Channel

Deepening the Ohio River channel might be one way to increase freight-handling capacity of the system (more tons per tow-surface-area). However, from the beginning of the study – going back to an earlier Reconnaissance-level study -- there has been no interest expressed by navigation interests or any other group for overall deepening of the Federally-maintained Ohio River authorized shipping channel. Since the completion of the Ohio River canalization project

in 1929, the U.S. Government has maintained a 9-foot deep x 300-foot wide navigation channel between the lock and dam projects.

Deepening the channel would require combinations of the following:

- extensive and on-going dredging of long segments of the river, including areas currently not requiring maintenance dredging;
- raising the minimum “Normal Pool” levels – which would require modifications to many or all the lock and dam structures.

Thus, deepening of the channel was not considered for a number of reasons, particularly:

- No precedence for channel deepening has ever been established in recent Ohio River infrastructure feasibility reports (the Gallipolis, Olmsted and McAlpine authorization reports). All current structures and those under construction are designed expressly for an authorized 9-foot channel depth.
- There is no reason to believe such a deepening would be cost-effective, due to the associated expense of modifying 19 lock and dam structures.
- The environmental consequences of deepening – requiring dredging to levels well below current river strata -- are assumed to be a serious negative impact to river fish, wildlife, and plant-life. Also, the environmental impacts associated with disposal of large amounts of dredged materials would be a significant problem.

Constraint 2: Maximum Lock Size **Considered = 1200' L.x 110' W. (nominal dimensions)**

Assumption 2 is in some ways similar to Assumption 1 in that it is governed by the natural geometry of the river itself. Locks larger than the nominal size of 110' wide x 1200' long were not considered, based on previous input from commercial navigation interests.

Natural river geometry tends to limit tow sizes to about 108' wide x 1200' along most of the river – particularly in bend-way areas. Occasionally, a few companies run double-wide (30-barge) tows along portions of the lower Ohio and Tennessee Rivers, particularly during higher water periods. However, these tows arrange in advance to multiple-cut through the locks in 108'x1200' (or smaller) cuts. There has been no interest expressed in the massive investment required to change the maximum lock size beyond the nominal size of 110'x1200' -- at least not in the foreseeable future.

Constraint #3: Minimize Impacts to Ohio River Floodways

The Federal Emergency Management Administration (FEMA) and individual states along the Ohio River have attempted to curtail construction in flood prone areas. The 1%-Chance

Exceedence Flood Frequency (which is commonly called the 100-year flood) was chosen as the base flood by many of these states for management purposes. The area that is flooded by this flood is called the 100-year *floodplain*. A floodplain differs somewhat from the definition of floodway. A *floodway* is defined in the National Flood Insurance program as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base (100-year frequency) flood without cumulatively increasing the water-surface elevation more than a designated height.

The designated height should be no greater than one foot, unless state or local regulation mandates a smaller increase. The designated height for the states that border the Ohio River have changed over the years. Presently the designated heights (encroachment) value is one foot in Kentucky (except 0.1 foot for Jefferson County which includes Louisville), Ohio, and West Virginia. Indiana uses a 0.1 foot encroachment. However, an Indiana Department of Natural Resources's (IDNR) Division of Water 17 July 1995 letter stated that a hydraulic assessment would be required only if the total floodplain cross sectional area obstructed by the project during a 100-year flood event is more than 5% of the pre-project area. In an area similar to the J.T. Myers area where the flood plain exceeds a mile for this flood event, the IDNR position was that a model would not be required. However, this office stated there is no language within the Flood Control Act or the Navigable Waterways Act that exempts the federal government from the State's permitting process.

The area between the floodway limits and the edge of the floodplain is called the *Flood Fringe*. Construction is usually allowed in the fringe area provided that the structure's lowest livable area is at least one foot above the 100-year flood elevation. In the ORMSS, there were early concerns that the deposition of material from an enlarged lock or especially from a completely new lock (that would be on government property) could raise elevations and impact habitats within the flood fringe. However, the final (extension) plans documented herein produce fairly minor spoil-area requirements – and these spoils can largely be placed without measurable impacts to flood flows. During Preconstruction Engineering Design (PED), the Corps of Engineers will prepare a Detailed Project Report and prepare associated analyses and documentation under the National Environmental Policy Act to further evaluate disposal options at John T. Myers Locks and Dam. This process will result in final selection and design of disposal area(s).

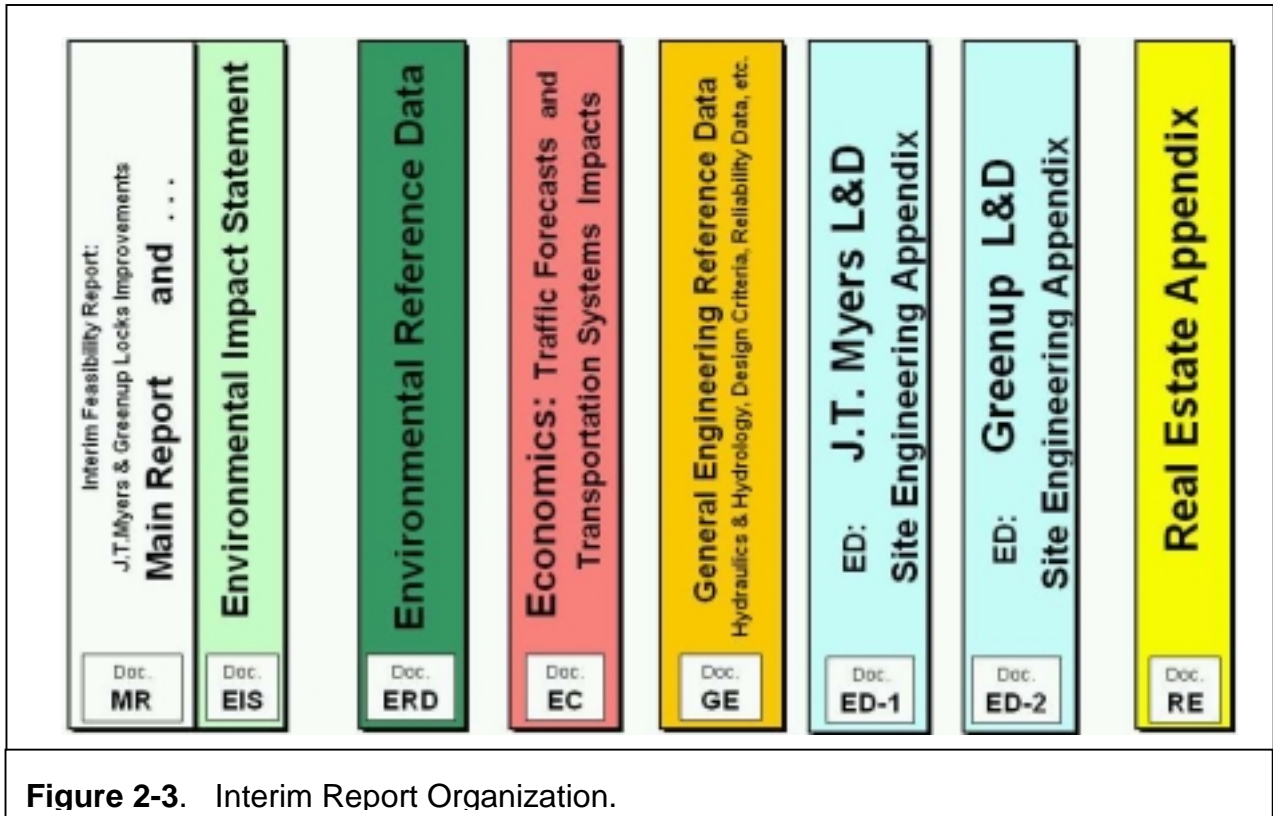
It has been determined that impacts to Ohio River floodways will be nil or immeasurably low based on:

- Feasibility-level designs per this report;
- hydrological flow modeling accomplished to date delineating floodways;
- and discussions with impacted-states Water officials.

Care will be taken in final plan design (during Preliminary Engineering and Design stage) to assure compliance with appropriate Federal and states' floodplain and floodway regulations.

REPORT ORGANIZATION

Because of the detail required in a study of this type, and the need to address issues to various audiences, this final Interim report is divided into seven separate volumes or “Documents”. Figure 2-3 shows these volumes in a pictorial illustration.



STUDY PARTICIPANTS

ORMSS participants are grouped into three major categories, and sub-categories, as shown below:

Technical Study Team

- U.S. Army Engineer District, Louisville
- U.S. Army Engineer District, Huntington
- U.S. Army Engineer District, Pittsburgh
- U.S. Fish and Wildlife Agency Field Offices in :
 - Cookeville, Tennessee
 - Bloomington, Indiana
 - Elkins, West Virginia
 - Reynoldsville, Ohio
 - State College, Pennsylvania

- State Natural Resources' agencies:
 - Kentucky Dept. of Fish & Wildlife Resources
 - Illinois Dept. of Natural Resources
 - Indiana Dept. of Natural Resources
 - Ohio Dept. of Natural Resources
 - Pennsylvania Dept. of Natural Resources
 - West Virginia Dept. of Natural Resources
- State Historical Preservation Officers :
 - Kentucky
 - Illinois
 - Indiana
 - Ohio
 - Pennsylvania
 - West Virginia
- Study Team Navigation Design Consultants:
 - INCA Engineers (Bellevue, WA)
 - Black & Veatch Engineers (Overland Park, KS)
- Study Team Economics and Transportation Consultants
 - Center for Transportation Analysis, Oak Ridge National Laboratory (Oak Ridge, TN)
- Study Team Environmental Consultants
 - The Mangi Environmental Group, Inc.
 - Gulf Engineers and Consultants
 - Parsons Engineering Science, Inc.
- Study Team Cultural Resources Consultants
 - Gray and Pape (Cincinnati, OH)

Independent Technical Review (Quality Control)

- U.S. Army Engineer District, Nashville (lead and coordination)
- U.S. Army Engineer Great Lakes and Ohio River Division, Chicago Regional Office
- Planning and Management Consultants, Ltd.
- Skees Engineering, Inc.
- DOXA, Inc.

Primary Navigation Interests

- Inland Waterways Users Board (established by Water Resources Development Act of 1986)
- The Association for Development of Inland Navigation in America's Ohio Valley (DINAMO), whose Board of Directors include:
 - Secretary, West Virginia Department of Transportation
 - Special Assistant to the Governor, Commonwealth of Kentucky
 - the President of the American Waterways Operators (AWO)
- Huntington Navigation Advisory Committee
- Waterways Association of Pittsburgh
- Port of Pittsburgh Commission

SECTION 3

PRIOR STUDIES AND REPORTS

In Fiscal Years 1990-91, funds were appropriated for an Interim Reconnaissance Report for Uniontown Lock and Dam (now J.T.Myers L&D). J.T.Myers Lock is located in the lower reaches of the Ohio River, about 30 miles downstream of Evansville, Indiana -- just upstream of the mouth of the Wabash River. The Uniontown Reconnaissance focused on only this one lock site, and in June 1991 a Reconnaissance Report was issued, which found positive benefits for traffic-capacity expansion at the Uniontown site. Corps Headquarters' review of this Reconnaissance Report, dated 14 February 92, stated:

The Corps must take a "systems look" to properly address the level of investments needed to continue to provide a viable navigation system *on the Ohio River Mainstem*. ... the entire Ohio River Mainstem navigation system should be carefully reviewed, but your primary emphasis for this study should concentrate on the lower portion of the river.

The following table summarizes major decision documents pertinent to the Ohio River Mainstem Study, particularly those relevant to J.T. Myers and Greenup Locks & Dams. A more comprehensive list of prior reports, including technical documents, are listed in the General Engineering Reference Data Appendix (Document GE).

**TABLE 3-1. LIST OF PRIOR MAJOR REPORTS pertinent to the
ORMSS MYERS/GREENUP INTERIM REPORT (sheet 1 of 2)**

Document Title	Date	Produced by	Summary	Conference or Reference
<i>Ohio River Basin Comprehensive Survey</i> in 14 volumes	Aug-69	Ohio R Basin Survey Coordinating Comm.: SCS, ERS, USFS, Corps of Engrs., Dept. of Comm., DHEW, Interior, FPC, states	A basin framework study covering economics, water supply, pollution, F&W resources, navigation, flood control, etc.	Water Resources Council Guidelines for Framework Studies, dated Oct 1967; and Council Memo of 22 Aug 68
<i>Ohio River Mainstem Nav Study Interim Reconnaissance Study Uniontown Locks & Dam</i>	1-Jun-91	CELRL-PDF	B/C for third 1200' chamber = 1.5. B/C for 600' chamber extension = 0.8.	Recon Review Conference., Louisville 17 Sept 91
<i>Ohio R. Mainstem System Study Project Study Plan (PSP) Revised June 96</i>	1-Jun-96	CELRL-PDF	Similar to Feb 96 PSP in terms of overall schedule and costs, but with 'Lower River' early actions removed.	CEORD memo to Dir. of Civil Works, HQUSACE, 10Apr96
<i>Ohio R. Navigation System Report, 1996 COMMERCE ON THE OHIO RIVER AND TRIBUTARIES</i>	1996	CELRL-NC	The Biennial Report of Commerce and a system-wide inventory of facilities on the Ohio River and its tributaries	not applicable
<i>OHIO RIVER NAVIGATION SYSTEM-- 1997 Statistical Supplement</i>	1997	CELRL-NC	Intervening-year statistical update to the biennial Ohio R. Nav. System Report (1996)	The publication also references other Waterway Data Publications and their sources as well as a World Wide Web data access site.
<i>ORMSS Field Inspection Report of all L&D Facilities on the Ohio River (Pittsburgh, Huntington & Louisville Districts)</i>	1996- 1997	CELRP-EDD; inspections by a core group of LRP/ LRH/ LRL engineers.	Details visual inspection of facilities at each L&D plus interviews with Lockmasters & projects' O&M Leaders. Provides numerical ratings for various L&D components, and photos of conditions at each L&D.	Various team and Oversight meetings -- comparative data to begin reliability analyses.

TABLE 3.1. LIST OF PRIOR MAJOR REPORTS pertinent to the ORMSS MYERS/GREENUP INTERIM REPORT (sheet 2 of 2)

Document Title	Date	Produced by	Summary	Conference or Reference	Disposition / Status
<i>ORMSS - 100% Submittal Constructibility and Cost Estimate (Analyses) for Prototype Alternatives (DACW27-95-C-0126)</i>	May-98	INCA Engineers (Bellevue, WA) for CELRL-ED	Descriptions, drawings, constructn schedules, & cost estimates for 9 configuratns of F/E systems. Constructibility evaluations.	Report requested by Plan Formulation and ED teams, and incorporates comments received from 10-11 March and District reviews.	Essentially, evaluated sensitivity of layout costs to various empty-fill configuration for both 600 Aux. Extensions, and 3rd lock plans.
REPORTS SPECIFIC to J.T. MYERS LOCKS and DAM, formerly 'Uniontown L&D' and vicinity (lower Ohio River areas)					
<i>Uniontown L&D (Replacement for L&Ds 48 & 49) Survey Scope</i>	Nov-57	Louisville District Engineering Div.	Document requesting authorization of Uniontown L&D project	Under authority of Section 6 of Rivers & Harbors Act of 3 March 1909	Uniontown L&D approved by the Chief of Engrs and by BERH. Authorized by Sec.Army 17 Sept 58.
<i>Uniontown L&D Design Memoranda (7 Memoranda and Supplements)</i>	1962 - 1966	CELRL-ED	Detailed technical data on siting and design of lock and dam structures	Under authority of Survey Scope document authorized by Sec.Army 17 Sept 58	Final drawings were prepared, and Uniontown L&D (now Myers L&D). constructed June 1965- Sept 1972.
<i>Information Brochure for Periodic Inspection, Uniontown L&D</i>	Jun-74	CELRL-ED	Reference data used for periodic inspections of the L&D facilities.	not applicable	Includes "as-built" drawings for Uniontown L&D (now Myers L&D). Constructed June 1965- Sept 1972.
<i>Final Technical Report H-75-9 Navigation Conditions at Uniontown L&D, Ohio River</i>	May-75	CEWES-HS	Pre-construction hydraulics model investigation for Uniontown L&D – replaced old L&Ds w/1-1200 ft lock & 1-600 ft lock + gated spillway and fixed overflow dam	not applicable	
REPORTS SPECIFIC to GREENUP LOCKS and DAM					
<i>Greenup Locks and Dam, Ohio River, Design Memo #1, Huntington District, Corps of Engineers</i>	Dec-53	CELRH-ED	General Design Memorandum – overall layout and design assumptions	NA	Beginning of Post-Authorization design work

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SECTION 4

OHIO RIVER NAVIGATION

This provides an overview of the Ohio River Navigation system – its geography, history, commerce and resources.

DESCRIPTION OF OHIO RIVER NAVIGATION SYSTEM

The study area includes the mainstem Ohio River, which extends from the junction of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, to near Cairo, Illinois where the Ohio joins the Mississippi River. This area includes 981 miles of commercially navigable channel and a total drainage area of 204,000 square miles. Year-round navigation is provided by a system of 20 locks and dams and annual maintenance dredging. The drainage area encompasses all or portions of fourteen states, including Alabama, Georgia, Kentucky, Indiana, Illinois, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The navigable tributary streams to the Ohio River are not part of this study (see Fig. 4-1).

The topography of the study area varies from rugged mountains to flat plains. The Appalachian Mountains dominates the eastern portion. West of these mountains and south of the Ohio River, the landscape contains considerable local relief, which gradually modifies to rolling plains through most of Kentucky and Tennessee. North of the Ohio River, broad valleys with only minor relief extend from southwestern and central Ohio through central Indiana into southern Illinois.

History of Development

Federal involvement in improving the Ohio River for commercial navigation began in 1824, when Congress directed the Corps to find a method of removing sandbars and snags. In 1906, the Rivers and Harbors Board recommended construction of 54 locks and dams providing a nine-foot channel the entire length of the Ohio River. This canalization initiative, which provided for 600-foot long lock chambers, was completed by the Corps between 1910 and 1929.

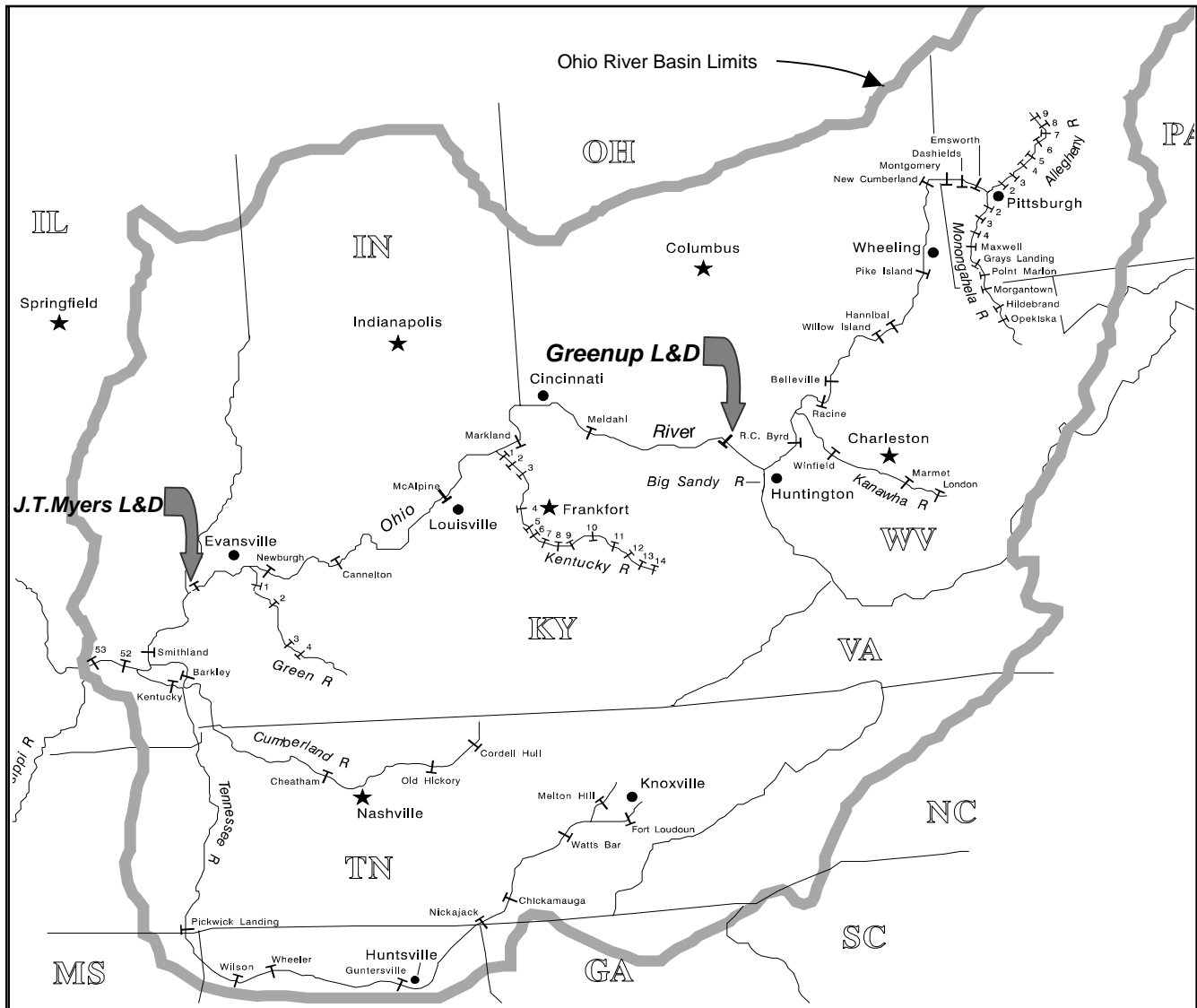


FIGURE 4.1. Ohio River Navigation System, highlighting locations of J.T. Myers and Greenup Locks and Dams.

Once canalization was completed in 1929, the waterway spurred economic growth and assisted the rapid nationwide mobilization during World War II. Sustained post-war expansion of the national economy increased the use of all types of commodities carried on the river. This rapid growth in traffic exceeded the government's ability to increase lock capacity and by the 1950s serious delay problems had become obvious. The original 600-foot lock chambers built during the days of paddleboats and wooden barges were obsolete and could not handle large modern tows in a single lockage.

Recent Locks and Dam Improvements

As increased navigation costs began to affect the region's economy, plans were formulated beginning in the 1950s to modernize the navigation system. The plan developed called for the replacement of earlier low-lift structures with a lesser number of high-lift locks. The modernized structures provide higher-lift dams, with longer pool-reaches between projects, and larger lock dimensions. The ORMS modernization program began in 1954 with construction of Greenup Locks and Dam, a structure with a 30-foot lift, a 1200 by 110-foot Main lock, and a 600 by 110-foot Auxiliary lock. The modernization program envisioned 19 modern high-lift projects. The current profile of the Ohio River mainstem is shown in Figure 4-2. The specifications for the existing mainstem lock and dam projects are listed in Table 4-1.

The modernization program continues today with improvement of Robert C. Byrd Locks and Dam (formerly Gallipolis) located just upstream of Huntington, West Virginia; Olmsted Locks and Dam on the lower Ohio River; and McAlpine Locks and Dam located near Louisville, Kentucky. In January 1993, the new Robert C. Byrd Locks, measuring 1200 by 110 feet and 600 by 110 feet, became operational -- replacing the small and outdated locks at Gallipolis; -major rehabilitation of the dam is ongoing and scheduled to be completed in September 2000. The new Olmsted Lock and Dam project at river mile 964.4 is currently under construction. The project, which will provide a modern structure to replace old Locks and Dam 52 and Locks and Dam 53, consists of twin 1200 by 110-foot locks and a new dam with submersible gates to allow tow passage over the dam during higher flow conditions. Construction was initiated in 1993 and is scheduled to be completed in the year 2008. With completion of Olmsted, the number of Ohio River mainstem projects will be reduced from 20 to 19. The Water Resources Development Act of 1990 authorized improvement of McAlpine Locks and Dam at river mile 606.8. The project is currently under construction, and scheduled for completion in 2006. It will replace the old 600' Auxiliary Lock with a new 1200' chamber -- providing this site with twin 1200 by 110-foot chambers.

The Ohio River is a vital transportation artery for the Ohio River basin states, as well as a large number of other states due to its interconnections with the Mississippi River, the Great Lakes, and U. S. coastal ports.

Current State of the Waterway

If reduced to a few brief statements, Existing Conditions on the Mainstem may be described as follows:

- A large canalized river consisting of 20 pools formed by 20 locks and dam structures. (After the completion of Olmsted L&D in 2008, which replaces L&Ds 52 and 53, there will be 19 pools and 19 locks and dam structures.) By *canalized* we mean that the original free-flowing river was controlled, starting over 100 years ago, into a series of relatively flat pools ("canals") for purposes of maintaining year-round navigation. See Figure 4-1 and Table 4-2. During high-flow periods,

particularly in late winter months, water levels may rise considerably above these lock and dam structures, and the river reverts more to a free-flowing environment.

- The current geometry of the river, as improved by the higher pool levels of the modernized dam system, generally provides for safe navigation of commercial tows as long as 1200' long x 108' wide. A typical large jumbo-hopper-barge tow consists of fifteen 195'x35' barges, plus a towboat of varying dimensions, resulting in a tow of about 1170'x105'. Occasionally, tows on the lowermost reaches of the Ohio, below Smithland L&D, operate in a double-wide configuration of 30 barges (5 long x 6 wide), typical of the larger tows on the lower Mississippi River. During winter months, these 6-barge-wide tows can navigate over the navigable wickets of Dams 52 and 53 (and after 2008 the wickets at the new Olmsted Dam). Such tows cannot navigate these reaches during the drier months, when they must use the locks at L&D 52 and 53.
- In terms of age and size, the locks and dam facilities may be classified into 3 broad groups:
 - The 60+ year old upper three structures (Emsworth, Dashields, and Montgomery L&Ds) just downstream of Pittsburgh PA. These 3 locks each have one 600'x110' Main chamber and a 360'x56' Auxiliary chamber. Fifteen-barge tows must be processed in double-cuts through the Main chamber, while tow sizes are limited to five-cuts in the small Auxiliary chamber.¹ The condition of these old structures, together with the inefficiently-small lock sizes, are major concerns – although lower traffic levels on the upper Ohio have pushed these problems into a lower priority stratum compared with Greenup and J.T.Myers Locks (the focus of this Interim Report).
 - The 13 modernized lock and dam structures constructed between 1954 and 1979, plus Byrd L&D which has new locks completed in 1995. This includes all the contiguous locks from New Cumberland downstream to J.T.Myers, a distance of 791.6 miles. Each of these newer locks has a 1200'x110' Main lock chamber and a 600'x110' Auxiliary chamber. The 1200' long Main chamber allows 15-barge tows to lock through in a single operation, while smaller tows or other vessels usually use the Auxiliary chambers. These newer locks and dams are spaced about 60 miles apart, on average, and replaced a series of about 40 old lower-lift structures built around the turn of the century.
 - Locks which have two side-by-side 1200'x110' locks. These include Smithland L&D (placed in operation in 1980), and Olmsted and McAlpine L&Ds, now under construction.

This Interim Report of the Ohio River Mainstem Systems Study will concern itself with the formulation of solutions at the two highest-priority structures needing improvement – namely J.T.Myers L&D (located just downstream of Uniontown, KY and Mt. Vernon, IN), and Greenup L&D (located between Greenup, KY and Portsmouth, OH). Section 5 will provide more details on Problems and Needs. Section 7 will describe the future expected Without-Project condition, and provide details on the rationale for priority action at the Myers and Greenup sites.

¹ Tows too large for a lock chamber are broken into smaller pieces, or cuts. Each cut is processed through the chamber individually. A tow that must be broken into two pieces is referred to as a double-cut, and its processing through the lock as a double-cut lockage.

Plan and Profile of the Ohio River Lock and Dam System

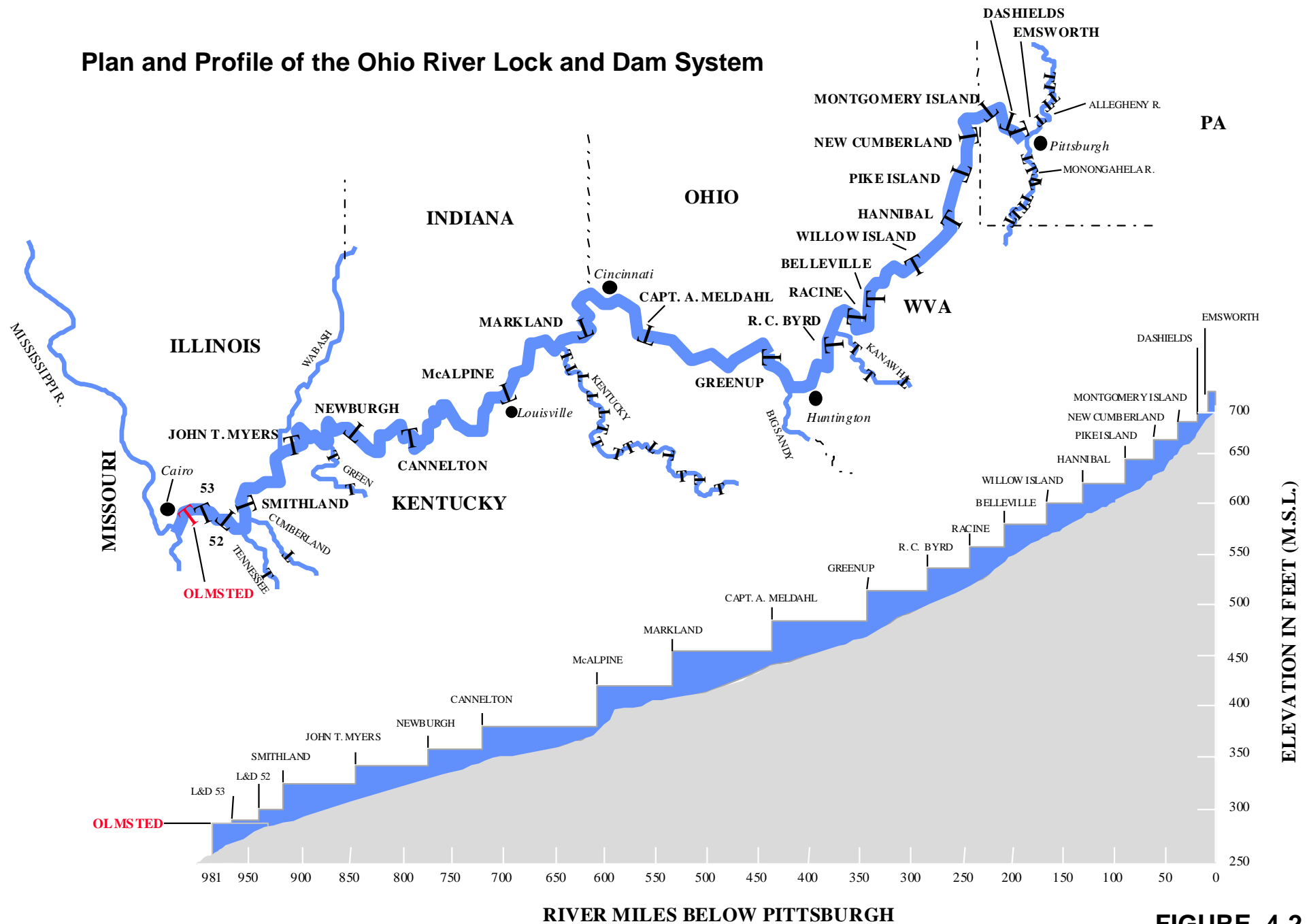


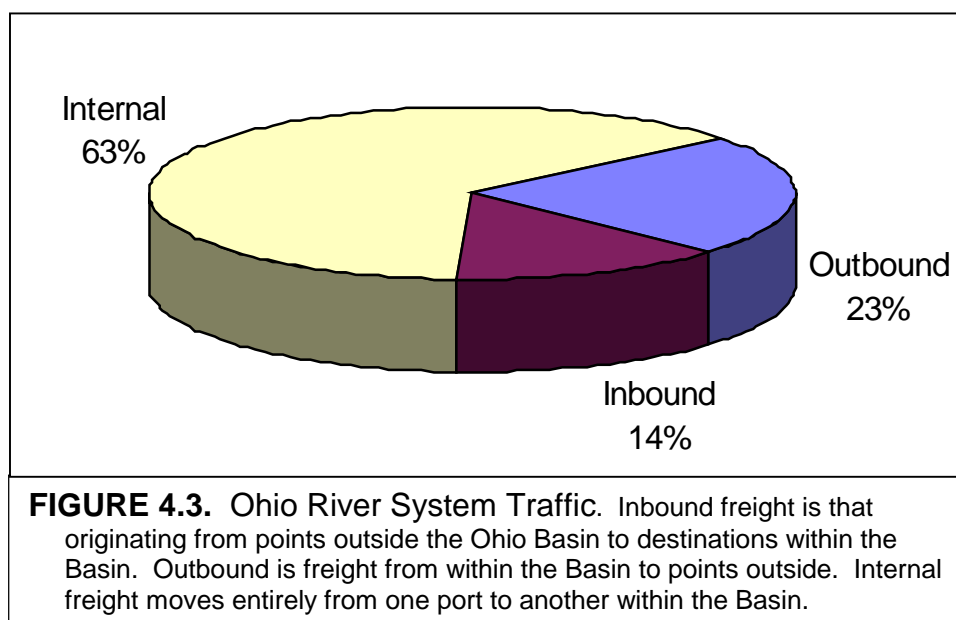
FIGURE 4-2

TABLE 4-1. Ohio River Lock Specifications

Lock & Dam Project Name	RiverMile (downstream of Pittsburgh)	Year Operational			Year Rehabilitated			Chamber Sizes	
		Main	Aux.	Dam	Main	Aux.	Dam	Main	Aux.
Emsworth	6.2	1921	1921	1922	1984	1984	1984	600x110	360x56
Dashields	13.3	1929	1929	1929	1990	1990	1990	600x110	360x56
Montgomery	31.7	1936	1936	1936	1989	1989	1989	600x110	360x56
N. Cumberland	54.4	1956	1959	1961				1200x110	600x110
Pike Island	84.2	1963	1963	1965				1200x110	600x110
Hannibal	126.4	1972	1972	1975				1200x110	600x110
Willow Island	162.4	1972	1972	1973				1200x110	600x110
Belleville	203.9	1968	1968	1969				1200x110	600x110
Racine	237.5	1967	1967	1970				1200x110	600x110
R.C. Byrd	279.2	1993	1993	1937			2000+	1200x110	600x110
Greenup	341.0	1959	1959	1962				1200x110	600x110
Meldahl	436.2	1962	1962	1964				1200x110	600x110
Markland	531.5	1959	1959	1964				1200x110	600x110
McAlpine	606.8	1961	1921	1964		1965		1200x110	600x110 ^a
Cannelton	720.7	1971	1971	1971				1200x110	600x110
Newburgh	776.1	1975	1975	1975				1200x110	600x110
J.T. Myers	846.0	1975	1975	1975				1200x110	600x110
Smithland	918.5	1979	1979	1979				1200x110	1200x110
L&D No. 52	938.9	1969	1928	1929	1983	1983	1984	1200x110	600x110 [*]
L&D No. 53	962.6	1980	1929	1929	1983	1982	1984	1200x110	600x110 [*]
Notes: ^a McAlpine Auxiliary is under construction. Will be replaced by a 1200'x110' by year 2006. [*] Olmsted L&D (now under construction near L&D53), will replace both L&D 52 and 53. Olmsted L&D will have 2 identical chambers, both of size 1200'x110' with completion by 2008. ⁺ R.C. Byrd Dam Major Rehabilitatn ongoing -- began 1993 with projected completion in 2000.									

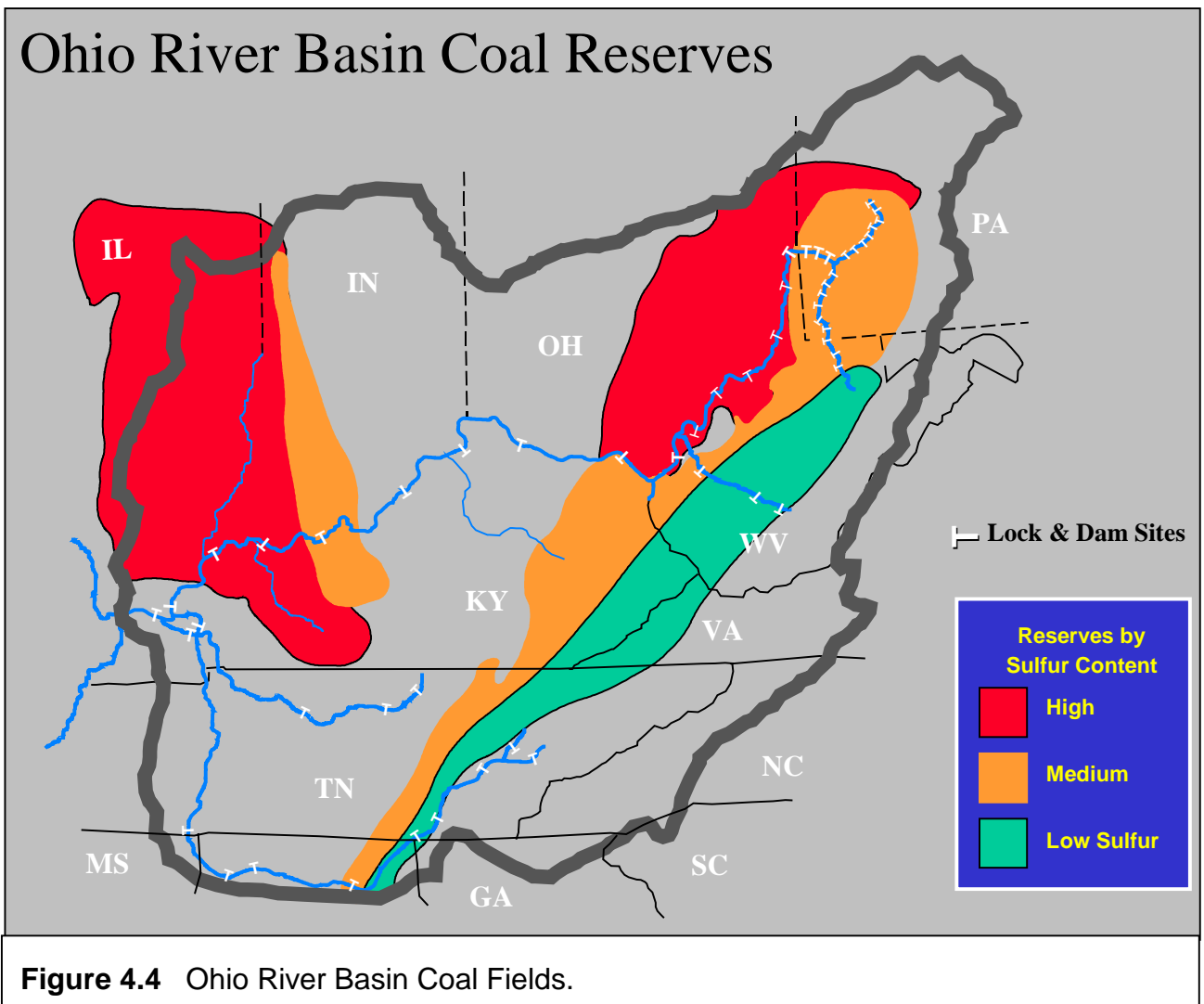
Tonnage Growth and Commodity Mix

The Ohio River Basin, that area drained by the Ohio River and its tributaries, is home to 25 million people. Pittsburgh, Cincinnati, Columbus, Indianapolis, Louisville, and Nashville are the region's largest cities. Waterborne commerce is made possible in the basin by a series of 60 lock and dam projects spread throughout the Ohio River and its 12 navigable tributaries (see Figure 4.1 above). In recent years barges on the Ohio River System (ORS) have carried approximately 260 million tons of commodities of navigable rivers. These commodities are the product of coal mines, petroleum refineries, stone quarries, cement plants, and farms and the raw material for construction companies, steel mills, electric utilities, paper plants, aluminum manufacturers, and chemical companies; the foundation of the region's economy. As can be seen in Figure 4.3 below, most of this traffic (63 percent) is internal to the ORS.



Basin river transportation consists largely of coal and other bulk or raw commodities -- goods with a long "shelf-life" and which are moved efficiently in large volumes. The ORS extends this efficient transportation mode deep into the interior of the North American continent. The availability of this form of transportation, along with the availability of rich deposits of coal (approximately 70 billion tons of demonstrated reserves), have made Pittsburgh, Pennsylvania and Huntington, West Virginia, the second and fourth largest coal ports, respectively, in the United States. Figure 4.4 is a map of the region's coal reserves.

Most of the basin's coal moves to domestic markets -- primarily to the electric utility industry. Over the last 30 years, much of the region's electricity generating capacity has moved away from small streams and large cities to more rural areas along the Ohio River and its system of navigable rivers. Dependable supplies of cooling water and access to low-cost transportation are the primary attractions. In fact, electric utility companies account for nearly half of system traffic.



The main artery of the Ohio River System is the mainstem Ohio. Eighty nine percent of system traffic moves on the Ohio River (see Table 4.2). Growth on the Ohio River has proceeded at a faster pace than the system as a whole, reflecting the relatively recent development of the Mainstem as compared with some of the tributary streams like the Monongahela River. In the past decade, growth on the mainstem Ohio has slowed somewhat from its rapid 1940-1990 pace. Yet, the Mainstem continues to set new records for traffic, reaching a peak of 241 million tons in 1997.

Like the system, Ohio River Mainstem traffic is dominated by coal transportation (see Table 4.3). Of all commodities, coal has grown by the greatest amount over the last 10 years, but other commodities have grown at faster rates. Aggregates, ores and minerals, and iron and steel products all grew at average annual rates in excess of 4.0 percent annually. Petroleum products and chemicals (accounting for less than 10 percent of total Ohio River Mainstem traffic) showed traffic declines.

TABLE 4.2 Historic Ohio River System and Mainstem Ohio Traffic

Year	Mainstem (Mtons)	% of Total	ORS Total (Mtons)
1940	29.5	58%	51.2
1950	48.6	74%	66.1
1960	79.5	75%	105.3
1970	129.6	79%	163.9
1980	155.9	87%	179.3
1990	225.7	88%	257.8
1996	239.0	89%	267.2
1997	241.3	89%	271.5
Average Annual Percent Growth			
1940-1990	4.2%	NA	3.3%
1990-1997	1.0%	NA	0.7%

TABLE 4-3. Historic Ohio River Mainstem Traffic, by Commodity (Mtons)

Year	Coal	Petro	Aggregates	Grain	Chemicals	Ores	Iron	Other	Total
1965	46.6	20.5	14.2	2.6	6.0	7.6	3.4	2.3	103.2
1970	59.0	25.3	17.2	3.6	10.6	3.9	4.4	5.5	129.5
1975	73.3	19.6	16.5	4.1	9.1	3.5	3.9	10.1	140.1
1980	86.1	18.3	21.2	6.7	11.5	3.2	4.1	9.6	160.7
1981	94.1	15.2	18.6	8.4	10.8	3.9	4.1	9.4	164.5
1982	87.9	13.3	14.1	11.7	9.1	2.3	2.6	9.7	150.7
1983	85.4	12.7	15.3	9.8	10.7	2.2	3.4	10.9	150.4
1984	102.2	13.5	16.4	9.1	13.1	3.1	5.0	12.4	174.8
1985	98.2	12.5	20.9	11.7	12.7	3.5	5.0	13.4	177.9
1986	112.5	13.4	24.4	10.0	12.2	3.0	5.7	14.8	196.0
1987	114.7	14.0	28.0	12.6	12.4	2.7	5.9	8.2	198.5
1988	110.9	13.8	27.3	11.5	13.1	3.1	6.0	9.1	194.8
1989	115.8	14.1	29.0	14.3	11.6	3.2	6.5	9.3	203.7
1990	135.1	14.4	30.4	13.2	9.3	5.5	6.5	11.2	225.6
1991	131.6	13.9	27.0	10.2	9.7	5.7	6.2	14.8	219.1
1992	135.3	13.3	28.1	11.3	10.1	5.5	5.8	18.1	227.5
1993	130.1	13.4	29.9	14.0	10.5	5.8	7.3	17.5	228.5
1994	134.8	14.2	32.6	12.0	10.6	6.5	9.6	17.8	238.1
1995	130.3	13.6	33.4	12.0	10.7	6.7	10.1	19.0	235.8
1996	134.8	13.3	37.4	10.7	9.9	7.5	9.7	15.7	239.0
1997	135.1	12.9	40.2	10.9	10.1	6.8	9.5	15.8	241.3
Avg. Ann. Growth Rate (65-97)	3.38%	-1.44%	3.31%	4.58%	1.64%	-0.35%	3.26%	6.21%	2.69%
Recent AA Growth Rate (87-97)	1.65%	-0.81%	3.68%	-1.4%	-2.03%	9.68%	4.88%	6.78%	1.97%
Source: WCSC Data									

Environmental Setting

Below is general information on the environmental setting of the Ohio River Mainstem. More detailed information is available in the EIS (attached).

Natural Resources

The Ohio River has a rich mix of culture, commerce, and natural resources. It crosses 19 watersheds and has been nominated recently as an American Heritage River. The river basin ecosystem, of which the Ohio River is its backbone, drains a total area of approximately 141,000 square miles. The rich flora and fauna of this ecosystem reflects its diverse and unique geologic past. Numerous fish, wildlife and associated plant species occur in the ecosystem, including many federally listed threatened and endangered species, such as mussels, fishes and birds. To date, approximately 164 species of fish have been collected from the Ohio River, including fish such as walleye and carp. Approximately 116 species of freshwater mussels can be found in the Ohio River, where 46 of those species are classified as endangered or species of concern.

Due to the Ohio River ecosystem's central geographic location, the area supports species with both southern and northern tendencies, as well as those common to the central portion of the eastern United States. The Ohio River and its back channels have been recognized for several years as having high quality fish and wildlife resources. The river provides some of the region's highest quality riverine, wetland, and bottomland habitats, and is used extensively by migratory and resident waterfowl, shorebirds and songbirds. The rich floodplain and wetland habitats along its shoreline provide critical habitat for rare and unique plant and animal species. The wetland habitat has been reduced over time; however, small isolated patches of wetlands do remain.

Islands of the Ohio River contain vital riparian and bottomland hardwood forest habitats also, where several national wildlife refuges have been established. Other diverse habitats including backwaters, submerged and emergent aquatic vegetation, sandbars, gravel bars, riffles and pools provide specialized environments for a wide range of riverine species. The habitat diversity of the Ohio River is extremely important to all aquatic species and wildlife that utilize the river.

Cultural Resources

Humans have inhabited the Ohio River Valley for at least the last 13,000 years. Prehistoric peoples built towns along its shores and transported exotic materials and ceremonial items up and down the river. Native people exploited the abundant and changing natural resources found along the river and in the valley since arriving in the area. In doing so, they left behind traces of their actions including hunting and gathering sites, habitation and camp sites, ceremonial and sacred sites, quarries and burials and many other types of sites and associated artifacts.

The cultural resources found in the Ohio River Valley tell the story of changing environments and human adaptation to these changes. As the environment changed over time, and floral and faunal populations adapted, human populations and technology altered too.

Populations became less migratory and more sedentary as food sources became more secure. They began practicing horticulture and using domesticated animals. Human populations increased and new communities developed. Societies changed as chiefdoms developed. Large ceremonial and burial mounds arose. Conflicts between groups took place. Trade and commerce was common between groups. Chiefdoms dwindled and were replaced. All of these activities are reflected in the archaeological record found along the entire length of the Ohio River.

European arrival dramatically changed the use of the Ohio River Valley. The valley and river continued to be a major transportation route, but over time settlers brought increased agriculture, industry and development. They built small farms and large plantations. Slave and free blacks had communities. Prior to the Civil War, the river had great significance as the boundary between slaves and free states, and a great deal of activity took place along the river to help African-Americans find safe passage to the North. The Civil War raged throughout the Ohio River Valley. Immigration is reflected in architecture and in the cultures found in neighboring cities and towns. The valley has diverse historic sites, architecture and artifacts.

The Ohio River Valley has a dynamic and diverse history that reaches back over 13,000 years. The river valley will continue to foster an understanding of history as artifacts are uncovered.

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SECTION 5

PROBLEMS, NEEDS AND OPPORTUNITIES

This section provides an introduction to the problems, needs and opportunities that have led to the production of this Interim Report. A more detailed description of problems on the Ohio River Mainstem, focusing on system economics, is provided later in Section 7 (a discussion of the system's Without-Project Condition). Section 7 also provides, by way of charts, figures, and other numerical data, the analysis supporting the need for advancing J.T. Myers and Greenup Locks and Dams improvements in this Interim Report.

BACKGROUND

A system of infrastructure as large as the Ohio River lock and dam system requires frequent maintenance, ranging from small adjustments and repairs to major component replacements. Certain major components and concrete-conditions are being studied within a risk and reliability (statistical) framework. This Interim report includes data from the reliability work completed to date, especially data concerning the Myers and Greenup sites. Reliability studies are discussed in detail in the General Engineering Reference Data appendix (Document "GE").

When facilities (such as lock structures) deteriorate significantly, the rehabilitation of the facility is usually evaluated. By definition, Major Rehabilitation (or MR) is a specific category of maintenance and of funding. There are two sub-categories of MR – (1) "Reliability" and (2) "Efficiency" -- but this Interim Report will deal on with Reliability-driven MR. By regulation, any Reliability-driven MR project:

- requires approval by the Secretary of the Army, and budgeted out of the Construction General (CG) Civil Works appropriation for the Corps of Engineers;
- requires over two Fiscal Years to complete;
- costs over \$9.4 million (in 1999\$) – this threshold is adjusted annually by regulation; and
- requires, for inland locks, 50/50 cost-sharing with the Inland Waterways Users Trust Fund.

To the extent that Major Rehabilitation is necessary for continued operation at any of the 19 Mainstem projects over the 50-period planning horizon, it has been included as part of the economic analysis of the Without-Project condition.

Lock and/or dam maintenance, whether minor maintenance (over a few days) or more extensive work lasting several weeks or months to replace major components of the lock chamber

(including MR work), often interferes with and delays the passage of vessels through the navigation system. Delays during Main-chamber maintenance closures is the primary problem addressed by this report.

The number and duration of maintenance closures at any lock will be impacted by the maintenance policy, primarily consisting of degree of preventive maintenance on major lock components. Preventive maintenance includes inspections, maintenance dewaterings and scheduled component replacement. The goal of preventive maintenance is to avoid component failures and the need for unscheduled repairs.

Thus, there are three specific problems considered by this Interim Report:

- (1) Main-chamber delays due to component replacement needs, including unscheduled and scheduled replacements. Major Rehabilitation efforts bundle the scheduled replacement or maintenance of several components if economically justified.
- (2) Main-chamber delays due to preventative maintenance, including routine or cyclic maintenance and inspections.
- (3) Routine delays during normal operations.

DELAYS DUE TO MAIN-CHAMBER MAINTENANCE CLOSURES

All 14 Ohio River locks and dams built during the 1950-1979 era modernization program (including R.C.Byrd L&D completed in 1993) have one long (1200' long x 110' wide) Main chamber, and a shorter (600' long x 110' wide) Auxiliary chamber. Rising traffic at these locks has caused serious traffic tie-ups whenever any of the Main (1200'-long) chambers are closed for maintenance. At such times, all traffic must process through the shorter Auxiliary chamber, and long tows (generally those with more than 6 barges) must break apart and process in two pieces – a double-cut lockage. Double-cutting of tows reduces vessel throughput by as much as 50-75%, and long vessel waiting-lines (queues) develop. Delay costs incurred by commercial shippers reach into the millions of dollars for such events.

A major effort of the Ohio River Mainstem System Study was comparison of alternative future maintenance scenarios (i.e., determination of the most-likely future Without-Project Condition, as detailed later in Section 7). In general, two main scenarios (different approaches to maintenance) were explored:

- **Baseline Maintenance Scenario** -- a reactive, fix-as-fail maintenance strategy. Normal operations and maintenance is performed, along with cyclical major maintenance for inspection, repair and adjustment of components and their sub-component features. No Major Rehabilitations occur, but individual components are replaced as they fail.
- **Maintenance & Major Rehab (M&MR) Scenario** -- major maintenance is periodically scheduled to inspect and repair sub-components and major components. With regard to component replacement, this maintenance scenario mimics current maintenance practices. Components are scheduled for replacement as required, and are bundled into Major Rehabilitations when economically justified.

These two policies would result in different timing and duration of chamber closures required to replace lock components. Closures in the Baseline Maintenance Scenario would likely be deferred to some degree as compared to the M&MR Scenario. However, the goal of the M&MR policy is to maximize net benefits through efficient maintenance of major lock components. Net benefits of the M&MR policy could be increased by reducing both the number total chamber closure days and associated disruptions to industry.

As will be discussed later in Section 7, the study's Economics team has run system-wide mathematical models, which estimate and sum-up future costs to waterway operators throughout the Ohio River system. Of the two maintenance philosophies displayed above, these models have found the M&MR scenario to be the Most-Likely future Without-Project Condition – in term of both optimum economics, and acceptability to waterway users who rely on a dependable navigation system. Even under this more efficient M&MR scenario, however, these models also show that delays due to maintenance closures to be the single greatest cost attributable to the lockage process. Lock delays are and will continue to be a particularly pronounced problem at Myers and Greenup Locks.

Focus on J.T.Myers and Greenup Locks

Of all structures and problems on the Mainstem, the Ohio River Mainstem System Study (ORMSS) economics analyses have shown the highest priority for delay-reduction improvements at J.T. Myers L&D (near Evansville, IN) and Greenup L&D (between Portsmouth, OH and Ashland, KY). Of the 14 locks with the shorter 600' Auxiliary chambers, these two structures have the highest traffic levels (both today and in the near-term future). Thus, cumulative delays at these two sites are forecast to be the greatest on the Ohio, unless further improvements are authorized.

Traffic Delays Due to Forecast Major Rehabilitation (MR) Needs

For Greenup Locks (placed in operation on 27 November 1959), reliability studies indicate that a Major Rehabilitation of the Main chamber gates and machinery is required between 2008 and 2009. A Major Rehab of the Auxiliary chamber is forecast for 2030-31, and of the Greenup Dam structure in 2043-45.

For Myers Lock, the only forecast Major Rehabilitation is of the dam structure, expected between 2050-53. Given the past maintenance cycles at Myers, it was determined the repair work to the locks (i.e., gates, lock walls, and lock machinery) could be more efficiently handled through a number of component replacements. These replacements do not meet current criteria for "Reliability-driven MR" work – they do not occur at common points-in-time, or else do not meet the current minimum cost threshold for MR work.

Delays due to Other Maintenance Closures

In addition to future MR events, a number of other less-costly maintenance events are anticipated on a somewhat regular cycle (and verified by reliability modeling). All anticipated maintenance events are listed in detail in the sample Cost and Closure matrices for both considered future maintenance strategies – the Baseline and the Most-Likely M&MR scenario – in Document PE. Traffic-cost implications of these closures are presented later in Section 7 (Figure 7-4). All future maintenance events will exacerbate delay problems at these two sites, unless major improvements are made over the next 8-10 years to reduce closure delays.

Figures 5-1 and 5-2 illustrate the rapid growth in average delay that is observed when a major maintenance event occurs at a lock -- based on 2 actual events. Figure 5-1 shows a growth in waiting time from just a few minutes per tow (on 10 Aug 89) to delays of near 4-days per tow by the time maintenance work is complete (on 24 Sept 89). Even after both chambers are restored to working order, it takes over 3 days for delays to drop down to normal levels at Myers (under 1 hour per vessel).

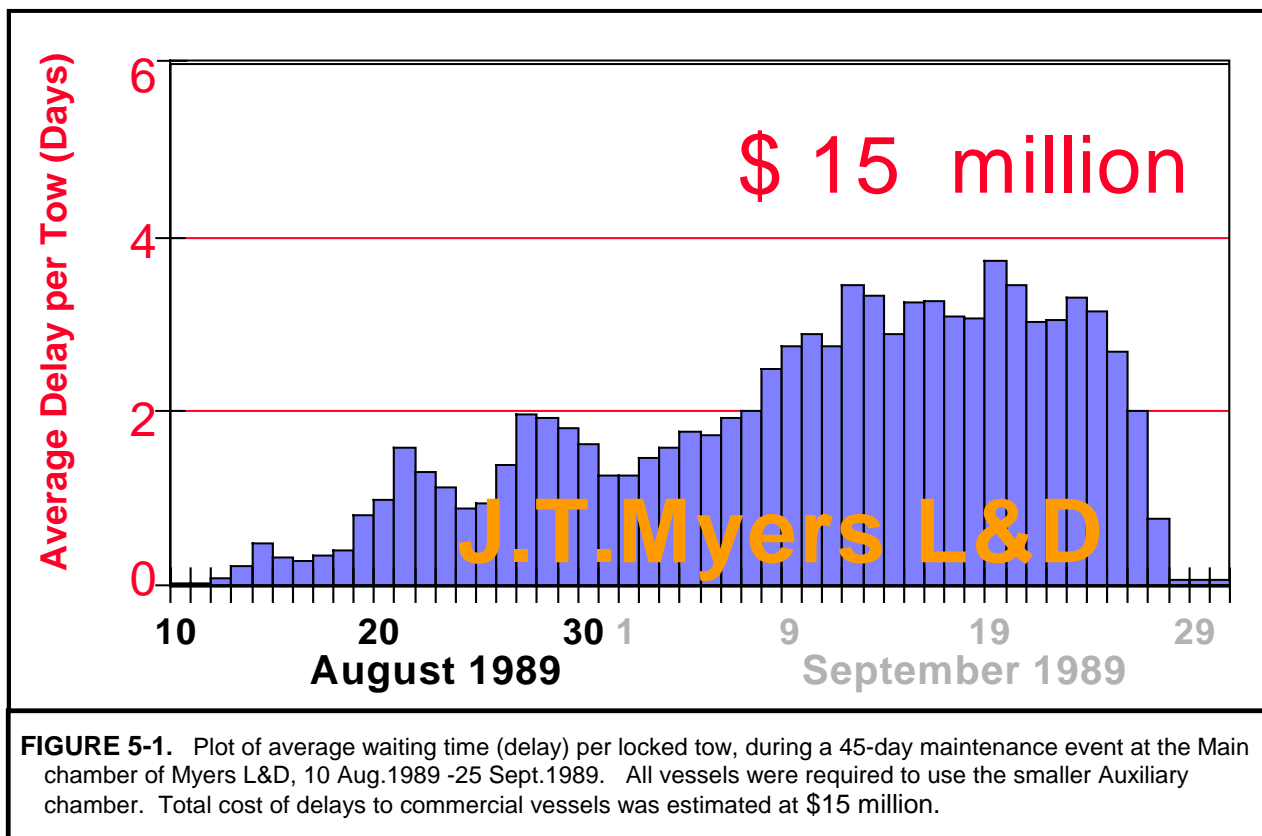
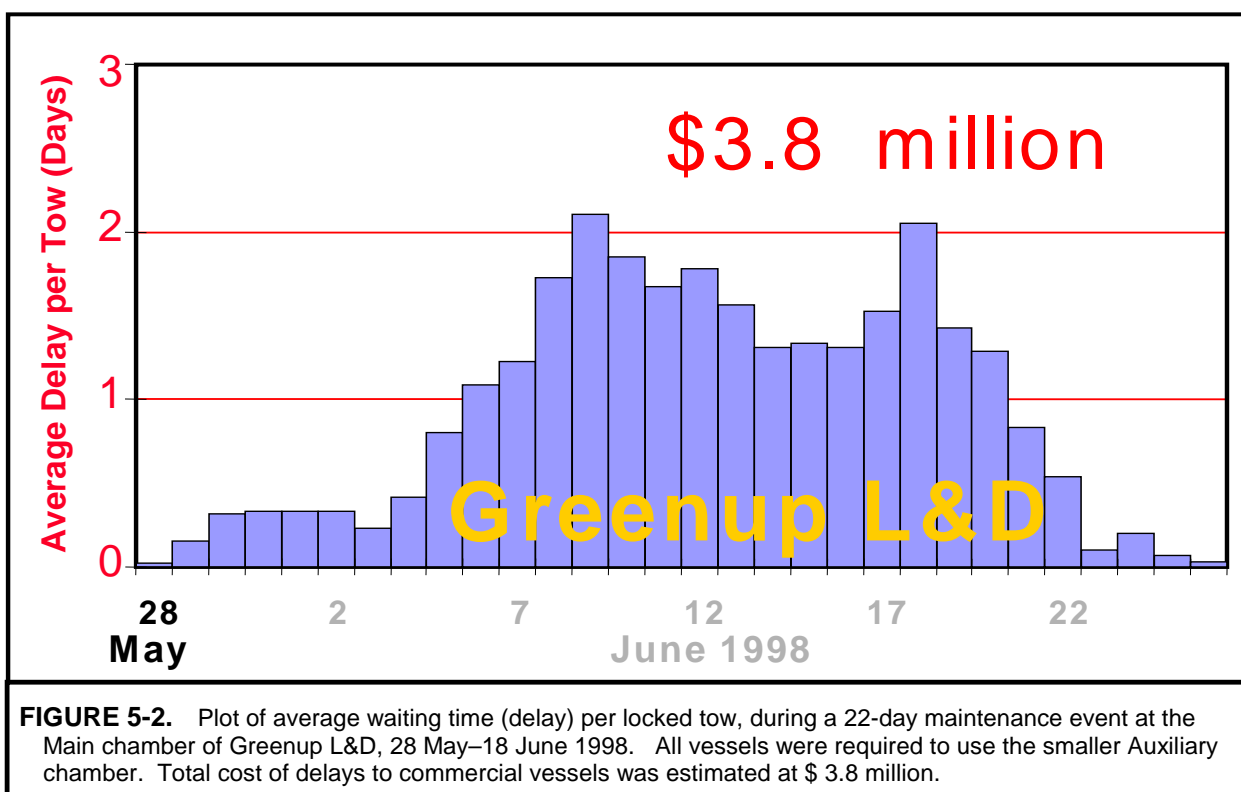


Figure 5-2 shows a similar, albeit shorter closure event at the Main chamber of Greenup Lock, in 1998. Figure 5-3 is a photo illustrating tow congestion during a lock closure.



Precise delay times and costs for lock-closure events can vary considerably from one event to the next, due to randomness (the position of vessels on the waterway prior to the closure), whether or not the closure was announced (whether or not shippers could anticipate or “work-around” the event), weather, and many other factors.

DELAYS DURING NORMAL OPERATIONS

In addition to delays caused by closures of the Main chambers at Ohio River locks, traffic delays at locks increase as traffic on the river increases – even when both chambers are functioning normally. At the two busiest of these structures, J.T. Myers and Greenup L&Ds, every-day waits (prior to lockage) of 40-50 minutes per vessel are common, and delays will rise yearly as traffic levels continue to grow.



FIGURE 5-3. Tows and their associated cargoes stranded in queue just upstream of McAlpine Lock near Louisville, following closure of the Main chamber at McAlpine Locks in 1997.

INVESTMENT OPPORTUNITIES

This section provides an introduction to possible solutions to the above delay problems. Means to ameliorate or eliminate closure-related congestion can be grouped into three categories, from least to more expensive: (1) non-structural improvements, (2) low-cost improvements, and (3) major structural improvements.

(1) Non-Structural Improvements:

These are methods that involve largely maintenance or operational changes (with little or no investment costs), and include the following:

- Review of various maintenance strategies to reduce closures times and/or to reduce the impacts of maintenance on waterway shipping. This has been a major topic of Reliability studies during the Ohio River Mainstem Systems Study.
- Implement a 6-tow-up / 6-tow-down lockage policy (queue discipline) whenever the Main chamber at Myers or Greenup locks is closed. This procedure is already used whenever major maintenance occurs at either of these locks. It takes advantage of the efficiency of proceeding with several successive “turnback”-style lockages in the same direction.
- Use of helper-tow boats to provide tow assists during Main-chamber shutdowns. This is generally accomplished through “industry self-help” -- whereby commercial motor vessels volunteer to aid other tows in making approaches or in pulling unpowered barge-cuts from the Auxiliary chamber.
- Congestion fees.
- Traffic scheduling, and / or re-scheduling of tows during chamber shutdowns.

Helper boats increase the efficiency of lockage through the Auxiliary chamber, particularly when double-cutting of long vessels is required. On the Ohio River, the use of helper boats is provided by the marine-industry’s “self help” program whenever the Main chamber is closed for an extended period – towboats waiting “back” in the queue volunteer their services for a few hours to extract unpowered vessel cuts out of the locks. Self-help is programmed into the transportation models for the ORMSS, and are assumed to be used in the future whenever Main chamber closures are scheduled which create queues of about 3 or more tows at any lock facility.

Congestion fees would, in effect, be a toll at a navigation lock that would attempt to eliminate marginally profitable shipments from the waterway thereby reducing the total traffic demand at a navigation project.

Traffic scheduling assumes that arrival times at a lock are assigned to particular vessels according to some set of sophisticated rules or priorities—something analogous to an air-traffic control system, but for the Ohio River traffic. Such a system would necessarily be computer-maintained, and would likely be expensive to organize and operate.

Somewhat analogous to traffic scheduling is a practice we might call “traffic re-scheduling”. By *re-scheduling*, we mean that commodity shipments planned for a specific

period of time are moved to another time period in response to an event beyond the carrier's control, like a labor strike, unexpected plant shutdown, or lock chamber closure. Re-scheduling is only one of the strategies that carriers currently employ when faced with a closure. The others include: 1) waiting in queue, 2) re-dispatching production among production facilities, and 3) re-routing shipments by alternate mode.

The Corps has no authority to direct shipments to be re-scheduled, but the towing industry does follow this practice in a limited, informal way whenever faced with these kinds of difficulties. Like the other strategies, re-scheduling is costly. The shipper may have to pay higher, short-term costs for waterway service. Stockpiles will either have to be built-up or drawn-down prematurely at an additional cost to the shipper, which in turn may involve additional handling costs.

Neither traffic scheduling or congestion fees are planned or included in the WOPC, because the Corps of Engineers does not have the current authority to implement these measures. However, some re-scheduling does occur by the towing industry during long lock closures to reduce the waiting time for tows at the locks, and this is reflected in the WOPC for the Ohio River Mainstem system (in the way that lock delays are computed by the Corps' transportation models.)

Congestion fees and scheduling were considered as With-Project alternatives, and are discussed in Section 11 and thereafter.

(2) Low-cost improvements:

For purposes of this study, **low-cost improvements** are considered to be plans costing less than \$15 million per site in initial investment costs (1999 price levels) – considerably lower than typical lock expansion options. Relatively low-cost improvements include:

- Provide mooring cells and /or buoys upstream or downstream of Myers and/or Greenup locks to reduce exchange or turnback approach and exit times.
- Make modifications to the locks' gate supports and provide a pair of spare gates at Myers and Greenup – as part of an eventual Miter Gate Quick Changeout System. This provides a faster means to repair gate problems by exchanging malfunctioning gates with a spare set stored at the lock site, and allows making repairs to the gates on dry land over an extended period of time, to optimize repair crew scheduling.
- Provide a lengthened upstream middle wall between Main and Auxiliary locks, particularly at busy locks such as Myers and Greenup (to be effective, this also requires lengthening the existing riverside guard wall). These approach wall improvements, particularly above the dam where approaches are most difficult due to out-drafts and tricky currents, provide “parking spaces” for tows or partial cuts, allows optimal use of turnback approaches, and reduces interference between the chambers, as far as the upper approach area are concerned. (See Figure 9-3). Guide/guard wall extensions were considered as part of lock extension plans – although it was also considered alone as a first-step improvement. Although extended guide/guard walls alone can increase capacity of the locks somewhat, the cost of this improvement may be justified ONLY in conjunction with lengthening the 600' Auxiliary chambers (as discussed below).

The above lower-cost improvements are all being evaluated as first-step increments (generally as part of the Without-Project Mainstem condition) prior to implementing more costly improvements at Myers and Greenup Locks.

Mooring buoys were evaluated for their ability to improve efficiency through shortened lock approach times (at a cost of only about \$50,000 per buoy) just downstream of the Greenup and Myers L&Ds. The design for these innovative buoys included materials, bottom-anchoring, and tow-attachment devices found preferable after discussions with pilots and reviews of other designs. Despite their relatively low cost, downstream buoys at these two sites do not improve approach times and were, therefore, not economically justified. Both Myers and Greenup already have mooring cells upstream of the locks, making buoys unnecessary on the upstream side of the projects.

Implementation of the Miter Gate Quick Changeout System, a low-cost capital improvement alternative, is economically justifiable at both the Myers and Greenup L&D sites. However, it did not prove to be as beneficial (alone) as the structural plan. Owing to its effectiveness in reducing closure periods, it was included in the With-Project formulation as part of the structural plan.

Guide/guard wall extensions are already as part of major structural improvement plans discussed below – although extensions were also considered alone as a first step incremental improvement. Although such improvements can increase capacity of the locks somewhat, they have no effect on lock efficiency when needed most—during closures of the Main chamber. This is because wall extensions act to reduce traffic interference between chambers, which is of no benefit when only one chamber is operating.

(3) Major Structural Improvements:

Opportunities for substantial delay reduction at Myers or Greenup L&Ds, requiring more major improvements are listed below. Innovative construction techniques would be employed to allow much of the construction to take place “in-the-wet” (without cofferdams) and utilizing pre-fabricated float-in or “lift-in” lock segments. Two major structural improvements were considered:

- Construct a third lock chamber of size 1200' x 110' at either or both sites, essentially allowing two-way processing of 15-barge (full-size) Ohio River tows. Locations both landward and riverward of the existing chamber were considered. Note, however, that constructing a third lock chamber at Greenup (at least on the land-side of the existing 600' Auxiliary), is difficult due to the presence of highway bridge piers, twin 26-inch natural gaslines, and overhead electric lines just land-side of the Auxiliary lock.
- Extend the existing 600' chambers to make them a minimum 1200' length. This results in two full-sized chambers at the lock site. The plan would include providing a lengthened upstream middle wall and river-side guard wall, plus a 1200' (approximate effective length) lower landside landing wall, to allow use of both chambers with minimum interference between the chambers' traffic.

Opportunities – A Summary

The above improvement concepts have all been considered as part of either the Without- or With-Project Condition for this Interim Report. The non-structural alternatives and the relatively inexpensive mooring buoy/cell options were considered as part of the Without-Project Condition, since they could be enacted under existing Corps authorities. The Without-Project Condition analysis is summarized in Section 7. The more expensive improvement opportunities were considered under With-Project formulation, and are discussed in detail in the With-Project formulation sections – these sections are grouped later in this report under “Part A” for Myers, and “Part B” for Greenup.

PLANNING OBJECTIVES

Now that the problems and needs to be addressed in this report have been introduced, and several alternative solutions have been discussed, a word is in order about planning objectives. By objectives is meant those criteria by which one alternative plan is weighed against another. The alternative or alternatives which best meets those objectives, after careful economic, environmental, institutional, and social-impact analyses would be the preferred plan(s).

For inland navigation systems studies (including this Ohio River Mainstem System Study, the objectives are:

- (1) **Ensure Future Navigability** – provide appropriate maintenance to existing navigation facilities (lock, dams, and channel improvements) and provide new, improved, or replacement facilities (as justified) to ensure continued and reliable navigation for nine-foot draft vessels throughout the length of the Ohio River.
- (2) **Improve Navigation Efficiency** – explore various options to schedule and execute maintenance as well as structural options so as maximize National Economic Development (N.E.D.) net benefits) – for example, by identifying cost-efficient measures to reduce transportation shipment costs.
- (3) **Conserve Fish and Wildlife Resources** – identify means within the authorities of the Corps of Engineers (or other agencies) to minimize degradation of fish and wildlife resources which might be caused by transportation or other commercial development, and / or to restore fish and wildlife habitats along and Ohio River to a more natural state where possible.

STUDY AREAS

J.T. MYERS L&D

Primary Study Area

J.T. Myers Locks and Dam (L&D) is located just downstream of Uniontown, KY (on the Kentucky shore) and Mt. Vernon, IN (on the Indiana shore), at Mile 846.0 on the Ohio River (miles downstream of Pittsburgh, PA). It is located on the Ohio River just upstream of the mouth of the Wabash River, which marks the common boundary point between Illinois, Kentucky, and Indiana (refer back to Figure 4-1). A map of the local area is shown in Figure 6-1.

The lock site itself is reached from the Indiana shore, just southwest of Mt. Vernon IN via State Highway 69. Mount Vernon IN, although a community of only about 12,000 population, is counted as the fifth largest riverport on the Ohio River, next to Pittsburgh, Cincinnati, Louisville, and Huntington. The town of Mount Vernon is located on an unusually high sediment bluff, and is one of the few river towns along the Lower Ohio safe from Ohio River flooding. As a result, a number of industries and shippers are located within 2 miles of the town center, including:

- The Indiana Port Commission's Southwest Maritime Centre,
- G.E. Lexan (plastics) plant,
- Babcock & Wilcock foundry,
- a large coal-rail transshipment facility within the Maritime Centre, and
- several other grain, gasoline, and stone terminals.

The area just north of the J.T. Myers L&D site is surrounded by several important fish and wildlife areas, including the Hovey Lake area.

Layout & Design of the Existing Project

J.T. Myers L&D is typical of the modern high-lift lock and dam projects built on the Ohio River from 1954-79. Starting with Greenup L&D in 1954, these projects were built to replace older "low-lift" wicket dams and locks, which had been constructed between 1900 and 1929.

The L&D structures built between 1954-79 all share several common features:

- One 1200' x 110' Main lock – capable of locking 15 “jumbo” barges and a towboat in a single operation.
- One 600' x 110' Auxiliary lock – capable of locking 6 jumbo barges and a towboat in a single operation. A 15-barge tow requires a double lockage – must be broken apart – to lock through this smaller chamber.

At J.T. Myers, the two lock chambers are located along the Indiana shore, or right bank (if facing downstream). The dam has a lift of 18 feet between *normal* (or “flat”, low-flow) lower and upper pools. It consists of a non-navigable gated structure extending from the locks towards mid-river, plus a 2100'-long section fixed-weir dam extending towards the Kentucky shore. The fixed-weir section, consisting largely of circular sheet-pile cells, is only slightly higher than the upper pool; tows can navigate directly over it during periods of extreme high water, without using the locks, although sufficient high-water occurs less than once every five years. The dam provides a pool with a minimum navigation depth of 9 feet, extending 70 miles upstream to Newburgh Locks and Dam. Many docking facilities in the Mt. Vernon and Evansville, IN harbor area are located within this pool.

Myers (originally called “Uniontown L&D”) was one of the more recent project completed during the Ohio River modernization program – i.e., the modernization that began in the 1950's. The navigation locks were placed in operation in 1975.

Construction – Employment Impact Area

The J.T.Myers Locks (considered work site) is approached from the Indiana shore of the river, and is located in Posey Co. Indiana, just southwest of Mt. Vernon, IN and near the Illinois border (which is formed by the Wabash River, just downstream of J.T.Myers. Also, Myers is located only about 30 miles west of the Evansville, IN-Henderson, KY metro area, where a major bridge links to Kentucky.

If a major navigation improvement were authorized at J.T. Myers, construction employment would be significantly impacted not only in Posey Co., but also nearby areas in Indiana, Illinois, and Kentucky. Depending on people's spending habits, the economic impact could be felt in a much larger area -- perhaps a dozen or more counties.

A construction employment and Regional Economic Development study was conducted for the final plans considered. Results of this analysis are provided in the Economics Appendix.



GREENUP L&D

Primary Study Area

Greenup Locks and Dam (L&D) is located just downstream of Greenup, and upstream of Portsmouth OH, at Mile 341.0 on the Ohio River (miles downstream of Pittsburgh, PA). It is located on the Ohio River downstream of the mouths of the Kanawha and Big Sandy Rivers (refer back to Figure 4-1). Both the Kanawha and Big Sandy Rivers are exporters of relatively high-quality Appalachian coal used primarily for electric power generation, and is also an important area for chemical production (in the Charleston area). In recent years, shipments of coal out of these two tributaries have significantly boosted traffic on the Ohio in the vicinity of Greenup Locks. A map of the local area is shown in Figure 6-2.

Layout & Design of the Existing Project

The project consists of two lock chambers located along the left bank (facing downstream). The Main lock is 110 feet by 1,200 feet and the smaller Auxiliary lock is 110 feet by 600 feet. The dam is a non-navigable gated structure with a lift of 30 feet between normal lower and upper pools. It provides a pool with a minimum navigation depth of 9 feet, extending 62 miles upstream to Robert C. Byrd Locks and Dam. Many docking facilities in the Huntington - Ashland - Ironton harbor area are located within this pool.

Greenup was the first project in the Ohio River modernization program that began in the 1950's. Greenup construction began in October 1954. The navigation locks were placed in operation in 1959 and the total project was completed in 1962. The project was designed so that a bridge could be constructed across the dam. A two-lane highway bridge constructed jointly by the Corps, the FHA, and the States of Ohio and Kentucky was completed in 1987. A hydroelectric power plant, under license from FERC, was constructed at the dam abutment on the right bank. The plant completed in 1982 has three turbines with a total generating capacity of 70 MW.

Construction – Employment Impact Area

Greenup Locks and Dam project site is located in Greenup County, Kentucky, midway between Ashland, Kentucky, and Portsmouth, Ohio. If a major navigation improvement is authorized at Greenup, it would significantly impact not only Greenup County, but also nearby areas in Kentucky and Ohio. Construction workers who commonly commute 50 miles or more would come from Greenup, Boyd, Lewis and perhaps Carter Counties in Kentucky, and Scioto, Lawrence and southern Pike counties in Ohio. Depending on people's spending habits, the economic impact could be felt in a much larger area -- perhaps in a dozen or more counties.

A construction employment and Regional Economic Development study was conducted for the final plans considered. Results of this analysis are provided in the Economics Appendix.

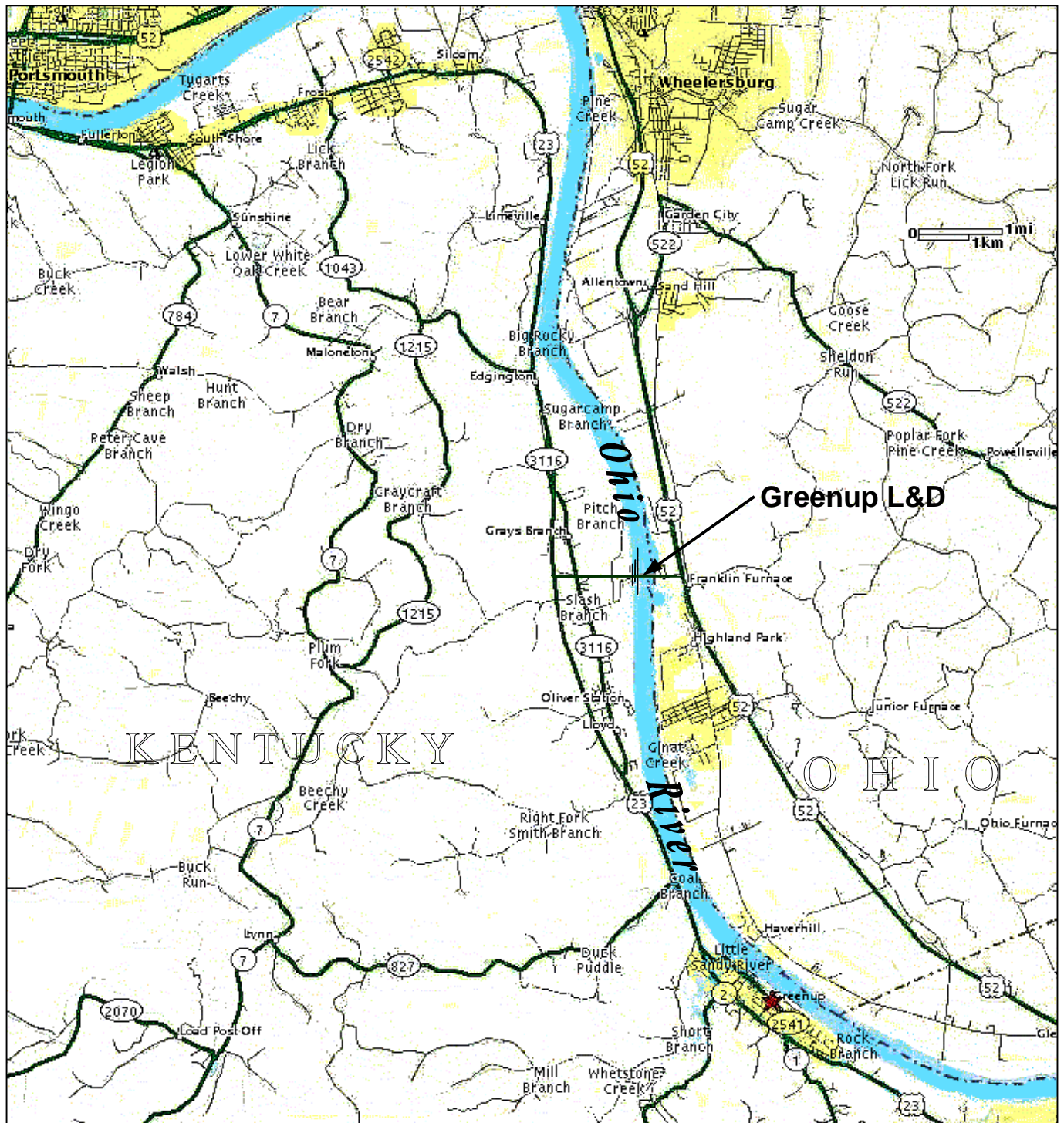


Figure 6-2. Greenup L&D and vicinity.

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SECTION 7

MAINSTEM OHIO RIVER WITHOUT-PROJECT FUTURE

The "Without-Project" condition (WOPC) may be defined as follows:

The ***Without-Project*** is the most likely condition expected to exist in the future in the absence of any change in law or public policy. The Without-Project condition includes any practice likely to be adopted in the private sector under existing law and policy, as well as actions that are part of broader private and public planning to alleviate transportation problems. Under Corps' Engineer Regulation 1105-2-100, the W/O condition will include consideration of the following practices:

- all reasonably expected non-structural practices within the discretion of the operation agency, including helper boats and lock operating policies, are implemented at the appropriate time;
- user charges and/or taxes required by law;
- normal operation and maintenance;
- alternative modes of transport are assumed to have sufficient capacity to handle future traffic volumes at current rates, unless there is evidence to the contrary.

The Without-Project condition includes the most likely condition expected to prevail on the Ohio River Mainstem in absence of additional (improvement) project authorizations. It is selected from a set of possible alternative Without-Project futures. The definition of the Without condition is important since it becomes the basis against which impacts of project improvements / additions are measured. For example, the net system-wide transportation savings (benefits less costs) of any With plan would be compared to the net transportation savings of the Without-Project Condition. Likewise, the environmental and social measures of any With plan would be compared to those of the Without-Project Condition.

Contrary to some belief, the definition or choice of the Without-Project Condition is NOT obvious -- **it is NOT necessarily the *status quo* or existing condition.** Quoting from the box above, the WOPC -- "any change in law or public policy" -- may still require certain improvements in the Corps' current ways of doing business.

Identification of the most likely future Without-Project condition (WOPC) is extremely important because it is used as the baseline for measuring incremental benefits, costs and other effects of alternative plans of improvement (the With-Project condition).

This section of the report develops and presents the most likely future Without-Project condition for the Ohio River Mainstem – the entire system of channels, pools, and lock and dam structures that provide year-round, 9-foot deep commercial navigation on the Ohio River. While the primary goal was to identify the most likely Without-Project condition, this process also served to identify any possible near term needs. As a result of this analysis, two projects were advanced for immediate treatment—J.T. Myers and Greenup Locks and Dams. Specific features of the most likely Without-Project condition (WOPC) for these two locks is presented in Sections 10 and 13.

Formulation of the WOPC begins with the system of existing locks, their current performance, and their structural condition. It is assumed that any reasonable and economically-justified nonstructural practice within the Corps of Engineers' discretion will be implemented at the appropriate future time. For example, operational alternatives, the use of helper boats, revised lockage policies, and various maintenance alternatives have been examined for their ability to improve project performance, insuring the best use of the existing facilities in the Without-Project future.

EXISTING CONDITION

The mainstem Ohio River is a system of 20 locks that create a series of navigation pools over the 981-mile length of the Ohio River. Today's system will be reduced to 19 locks upon completion of under-construction Olmsted Locks and Dam and the removal of Locks and Dams 52 and 53. Specifically, the ORMSS is evaluating the major maintenance, major rehabilitation, and new construction investment needs for these 19 navigation locks and dams. As navigation traffic grows on the Ohio River, several lock structures will experience increasing delays. These delays will be particularly severe during times of lock chamber maintenance, especially when the Main chamber at any one of these facilities must be closed for routine or emergency repairs or accidents. Other locks may become increasingly unreliable due to age and cycles of use. Therefore, assessing the structural reliability of these structures is an important component of this Without-Project evaluation.

This subsection describes the existing condition of the mainstem Ohio, the starting-off point for identifying the most likely WOPC. This discussion will focus on all Mainstem lock and dam facilities, particularly on the topics of:

- lock capacity,
- lock reliability,
- traffic and traffic delays.

Ultimately, any lock's performance capabilities are limited by two factors: 1) physical lock capacity and 2) structural reliability. The former is influenced by chamber dimensions, hydraulic conditions, vessel fleet characteristics, weather conditions, and even accident frequencies, while the latter is affected by a given project's structural condition and intensity of maintenance efforts.

This capability to process traffic placed in juxtaposition with traffic demands tests a lock's performance. Transit time and its most volatile component, lock delay, readily measure lock performance. The following discusses both the capabilities and performance of Ohio River locks. More specific discussion of the WOPC as it pertains to J.T. Myers and Greenup Locks and Dams are presented later in Section 8.

Capacity Considerations

A lock's capacity (its ability to handle a certain volume of traffic) is largely determined by the lock chambers' dimensions, approach conditions, the percentage of empty barges, and lock service availability. The three uppermost locks near Pittsburgh -- Emsworth, Dashields, and Montgomery (E-D-M) -- have a Main chamber measuring only 110' x 600' and an Auxiliary lock measuring 56' x 360'. They are the lowest capacity locks on the Ohio River (see **Table 7-1**). Modern fifteen barge tows must double-lock through the Main chambers at E-D-M, while in the Auxiliary chambers tows are typically limited to 5 barges and must lock through one barge at a time. At the other extreme, Smithland L&D, with the greatest capacity on the river, has twin (side-by-side) 110'x1200' chambers. Once authorized construction is completed, both McAlpine and the new Olmsted Locks and Dam (replacing Locks and Dams 52 and 53) will have twin 1200' chambers. For the Without-Project analysis, these authorized projects and associated capacities are assumed to be in-place. All other locks on the mainstem Ohio have a 110' x 1200' Main chamber and a 110' x 600' Auxiliary chamber (a configuration commonly referred to as a 1200' and a 600'). These project configurations form the basis for the evaluations of the various competing Without-Project alternatives.

Three non-structural alternatives are already components of the existing system:

- 1) a 6-up / 6-down queue discipline at locks (where this is beneficial) during Main chamber closures;
- 2) use helper towboats (assist vessels) during Main chamber closures, and
- 2) re-scheduling of shipments during long duration, scheduled Main chamber closures.

The use of helper-boats, through an industry "self-help" program, effectively maximizes the capacity of the small 56' x 360' auxiliaries on the upper Ohio and at the 110' x 600' Auxiliaries elsewhere.¹ These practices, along with limiting tow sizes to five cuts during Main chamber closures on the upper Ohio, are reflected in lock capacities reported in **Table 7-1**. Re-scheduling during closures re-distributes tow movements on either side of a closure situation. (By *re-scheduling* is meant that a towing company would avoid making movements through a facility affected by a Main chamber closure—i.e., would focus on haulage elsewhere on the system, at least for as long a period as possible.) Annual throughput, or capacity, is unaffected, but average delay per tow is lower than it would be otherwise.

¹ The self-help program at Emsworth, Dashields and Montgomery also includes a restriction on tow sizes to 5 barges-per-tow.

TABLE 7-1
Ohio River Mainstem Locks
Annual Capacity Estimates
(millions of tons)

Project	Operation of:		
	Main Only	Auxiliary Only	Both
Emsworth	31.5	15.0	40.4
Dashields	37.1	16.5	43.8
Montgomery	37.6	15.7	41.7
New Cumberland	85.4	41.0	119.5
Pike Island	104.0	51.8	147.3
Hannibal	114.4	63.4	169.7
Willow Island	118.2	59.1	159.8
Belleville	118.1	59.3	159.3
Racine	127.7	62.8	181.9
R.C. Byrd	98.6	59.4	148.5
Greenup	111.5	60.0	158.0
Meldahl	105.6	56.9	145.7
Markland	106.1	62.7	155.4
New McAlpine 1/	119.8	123.0	225.5
Cannelton	125.6	61.8	164.1
Newburgh	139.0	65.0	183.0
J.T. Myers	136.7	66.7	174.2
Smithland	128.3	129.0	246.7
Olmsted 1/	NA	NA	275.0

1/ Currently under construction.

Project Reliability

Lock performance is also affected by the availability of the lock for service. Availability is reduced due to random events most often related to accidents and adverse weather or flow conditions – and from maintenance-related closures. The latter events are more likely to be lengthy closures that dramatically affect lock performance than are the random closure events. Age and level of use can act as a rough proxy for major maintenance needs. By the year 2008, the first year a project might be brought on-line, Emsworth will be 91 years old, Dashields 83, and Montgomery 76 years old.² The next oldest locks will be nearing the end of their original 50 year design-life: New Cumberland and McAlpine (49 years old), Greenup and Meldahl (48 years old), and Markland (47 years old). Of this group, Greenup will be handling the greatest level of traffic.

² Emsworth, Dashields and Montgomery were all rehabilitated in the 1980s. These rehabilitations included installations of new miter gates, culvert valves, associated machinery, and re-facing some of the lock concrete structures. Nevertheless, there are still serious concerns regarding the structural integrity and stability of the concrete structures at these three sites. This is a continuing focus of engineering assessments for the final ORMSS Report.

Of course, age alone does not predict structural condition. Engineering reliability assessments of the mainstem locks provide a truer picture of need. Assessments based upon condition surveys, historic component performance, and engineering judgment were completed for all mainstem sites not currently under construction. In addition, full scale engineering reliability and subsequent economic analyses were completed for all the major lock components at the J.T. Myers and Greenup sites. Therefore, both J.T. Myers and Greenup have the reliability analyses embedded into the overall economic analysis. All other sites are based upon condition assessments and engineering judgment.

This type of analysis indicates likelihood of component failure based upon factor determinants such as age, usage, loads, existing condition of the component, rate of corrosion, and so on. Reliability analyses will be completed at the upper Ohio sites in the next interim report. All remaining sites will be completed as part of the final ORMSS report.

TABLE 7-2
Major Components Indicated for Replacement,
by Lock, Main Chamber Only

Component	Evansport	Duckside	Montgomery	New Cumberland	Pike Island	Hammond	Wilbur A.	Belleville	Revere	R.C. Byrd	Greenup	Middletown	Mockland	McAlpine	Canadian	Newburgh	J.T. Myers	Switzerland	Clinton
Miter Gates	none	none	none	R	R	R	R	R	R	none	R	R	R	R	R	none	none	R	none
Lockwalls	R	none	none	none	none	R	none	none	none	none	none	none	none	none	none	none	none	none	none
Guardwalls	R	R	R	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none
MG Monoliths	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none
MG Sills	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none	none
RT Culvert Valve	none	none	none	R	R	R	R	R	R	R	none	R	R	R	R	R	R	R	none
Hydraulic System	none	none	none	R	R	R	R	R	R	R	none	R	R	R	R	R	R	R	none
MG Machinery	none	none	none	R	R	R	R	R	R	R	none	R	R	R	R	R	none	R	none
CV Machinery	none	none	none	R	R	R	R	R	R	R	none	R	R	R	R	R	R	R	none
Electrical Systems	none	none	none	R	R	R	R	R	R	R	none	R	R	R	R	R	none	R	none

HF -- horizontally framed

CV -- culvert valve

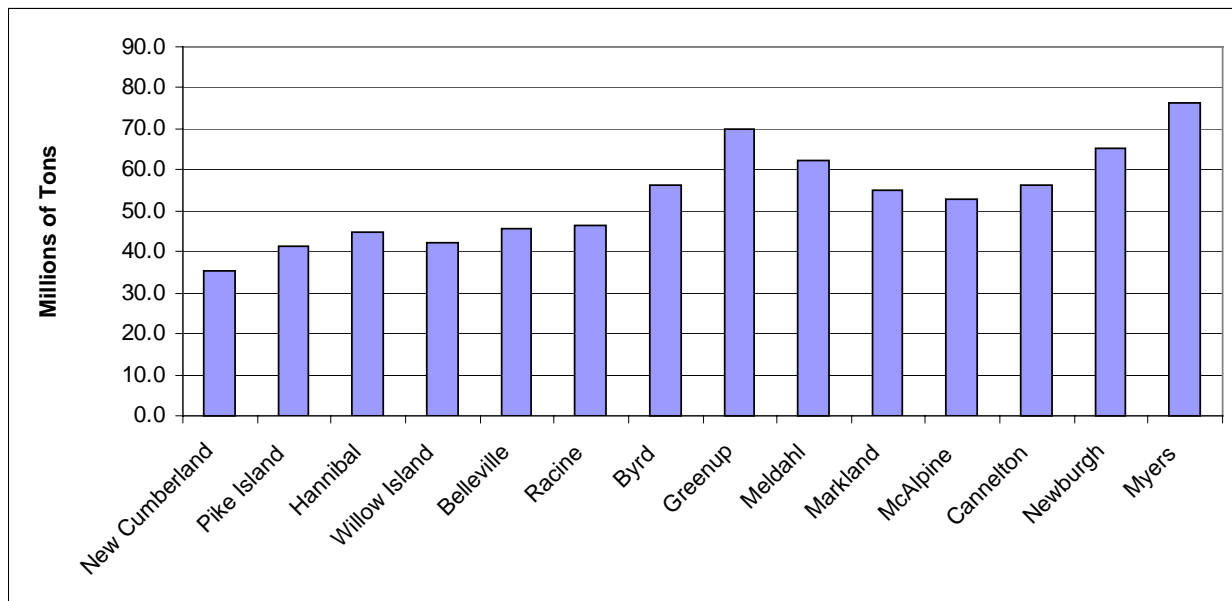
MG -- miter gate

R -- Replace or rehabilitate

Traffic Delays

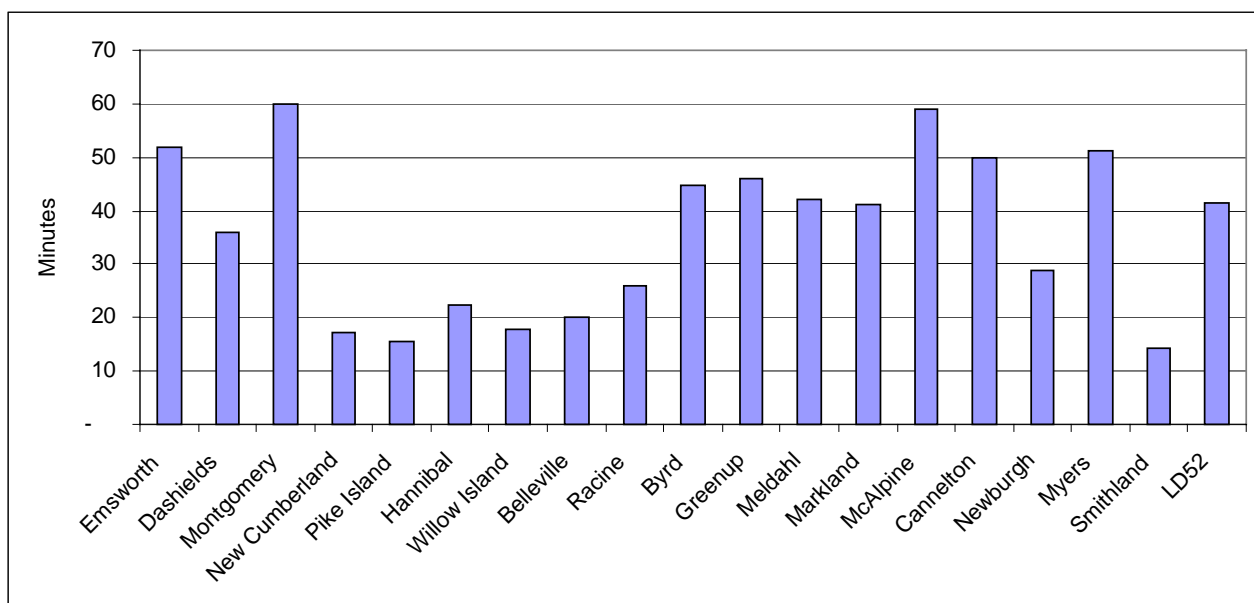
Total traffic on the Ohio River doubled between 1968 and 1996, when it reached 239 million tons. This growth has not been spread evenly along the river. Greenup and Byrd Locks, with an average annual growth of 4.1 percent between 1987 and 1997, were the fastest growing locks. Much of this rapid growth is attributable to electric utilities' reaction to the latest round of Clean Air Act Amendments (CAAA). This surge in traffic leaves Greenup second in total traffic to Myers among the projects with small 600' Auxiliary chambers (see **Figure 7-1**).

FIGURE 7-1
Traffic at Ohio River Mainstem Projects with 600' Auxiliaries, 1997



Delays are a function of a project's capacity and reliability, and of the traffic demands placed on the project. (**Delay** is defined as the average wait time per vessel before approaching the lock.) Delays during normal traffic operations typically range from less than ten to not more than 75 minutes at all mainstem locks, though delays can be expected to increase over time (see **Figure 7-2**). Excessive levels of delay do occur when the Main chamber is closed at any of these locks. Delays are most severe at the high traffic locks below R.C. Byrd Locks and Dams. A 44-day closure of the Main chamber at Myers in 1989 caused upwards of four days delay per tow and a 20-day closure at Greenup in 1998 caused delays per tow to exceed two days. This is not surprising given that the physical capacity of the small Auxiliary chamber at Greenup is estimated at 48 million tons, an annual ability overwhelmed by annual demands in 1997 that reached 70 million tons. These delays dramatically increase tow transit times and, therefore, tow transit costs. All significant Main chamber closures in recent years have been associated with maintaining project reliability.

FIGURE 7-2
Ohio River Mainstem, Average Lock Delays per Tow, 1993–1997



PRELIMINARY EVALUATION OF NONSTRUCTURAL ALTERNATIVES

Because maintenance and its effect on the satisfactory performance of the Mainstem's aging locks is a key concern, considerable effort was devoted to identifying the least-cost maintenance alternative. Of course, least-cost encompasses both repair costs and navigation industry disruption costs. Therefore, efficient operation of the existing structures is an important consideration. This is especially true during those times when the Main chamber is closed for maintenance, funneling traffic through the much smaller Auxiliary chambers. Both maintenance alternatives and operational alternatives are described below.

Maintenance Alternatives

Condition evaluations indicate that a number of Ohio River mainstem projects will require the repair and/or replacement of major lock components over the next 50 years. These requirements were summarized above in **Table 7-2**. This section describes two alternative scenarios for maintaining, repairing and replacing mainstem locks and their components:

- (1) the Baseline scenario, and
- (2) the Most Likely Maintenance and Major Rehabilitation (M&MR) scenario.

The Corps of Engineers currently pursues a proactive maintenance policy, scheduling the repair and replacement of these components in order to minimize the adverse industry effects associated with lock outages (a policy reflected in the M&MR). Current policy allows these component replacements to be bundled into Major Rehabilitation when economically justified. Alternatively, the Corps could pursue a more reactive maintenance policy (a policy reflected in the Baseline scenario). Both of these scenarios are discussed in more detail on the next page. Rather than maintaining components and sub-components through scheduled, periodic repair, these items would simply be repaired or replaced when they perform unsatisfactorily.

The expected performance of each of these two competing policies is numerically described in detailed cost and closure tables (matrices) for each Mainstem Ohio lock project -- by chamber and by year. Closure matrices show the yearly replacement costs and days that each chamber is out-of-service in order to complete the required work. In this interim report, these schedules are based upon engineering judgment and supporting condition studies at all sites, with the exception of J.T. Myers and Greenup locks and dam. Greenup and Myers L&Ds were initially based upon engineering judgment, but have been verified with engineering reliability analysis. Eventually all sites' cost and closure matrices will be developed in the same manner.

Baseline Scenario

The Baseline Scenario is a reactive, fix-as-fail maintenance strategy. Normal operation and maintenance is performed, along with cyclical major maintenance for inspection, repair and adjustment of components and their sub-component features. No Major Rehabilitation occurs, though individual components are replaced at their expected failure date.

Most Likely Maintenance & Major Rehab (M&MR)

As with the baseline scenario, normal operations and maintenance practices continue along with major maintenance to periodically inspect and repair sub-components and major components. With regard to component replacement, this maintenance scenario mimics current maintenance practices. Components are scheduled for replacement as required and are bundled into Major Rehabilitation when economically justified.

Past studies have relied upon condition studies and engineering judgment as formed by condition surveys, experience, and engineering standards to determine if and when a major lock component needed to be replaced. While this method continues to be relied upon in this interim report for most sites, reliability-based economic modeling is used to verify engineering judgement at J.T. Myers and Greenup; see Section 7.3.5 in the Economics Appendix for a discussion of reliability-based economic modeling using the Life Cycle Lock Model (LCLM). For those components where failure is indicated, the LCLM was used in conjunction with engineering reliability results to determine if scheduled replacement (indicated by a date in time in the table below) or fix-as-fail (indicated with FAF) is the most economical strategy. As can be seen in **Table 7-3** below, fix-as-fail is the best choice for most components where reliability is a concern. Again, these results have been incorporated into the cost and closure matrices for the M&MR scenario. More detailed discussion of this modeling is presented in the General Engineering (GE) document and in Attachment 2 of the Economics Appendix (document EC).

TABLE 7-3
Summary of Reliability-Based Component Replacement Needs
J.T. Myers and Greenup

Major Component	J.T. Myers		Greenup	
	Main	Auxiliary	Main	Auxiliary
Miter Gates	FAF	---	2004	2030
Lockwalls	---	---	---	---
Guardwalls	---	---	---	---
MG Monoliths	---	---	---	---
MG Sills	---	---	---	---
RT Culvert Valves	2030	2030	FAF	FAF
Hydraulic System	2020	2030	FAF	FAF
MG Machinery	FAF	FAF	FAF	FAF
CV Machinery	2030	2030	FAF	FAF
Electrical Systems	FAF	2030	FAF	2030

MG--miter gates

RT--reverse tainter

CV--culvert valves

Operational Alternatives

. During normal operations, project capacity is sufficient to handle traffic efficiently at all Mainstem projects throughout the 50-year planning horizon. However, closures of the Main chambers in the Without-Project condition cause traffic demands to overwhelm the small Auxiliary chambers at the high-traffic lower Ohio locks and at the upper Ohio locks. A number of nonstructural operational measures designed to improve lock efficiency, especially during closures, were considered. As discussed in Section 5, these operational alternatives include:

- A 6-tow-up / 6-tow-down lockage policy (queue discipline) whenever a Main is closed
- Use of helper-tow boats (“industry self-help”) to provide tow assists during Main-chamber shutdowns.

These measures are already in use at the Ohio River mainstem projects to improve lock efficiency. Additionally, towing companies and their customers re-schedule traffic to other times of the year or to other modes during Main chamber closures. The affect of this is captured in future traffic-delay relationships, but the additional costs involved have yet to be satisfactorily quantified. Current estimates of the Without-Project condition costs may, for that reason, be underestimated.

Hence, for nonstructural operational alternatives, no assessment of alternative Without-Project plans was required -- all reasonable operational measures are already in effect and are incorporated in both the Baseline and M&MR scenarios.

SYSTEM-WIDE WITHOUT-PROJECT CONDITION

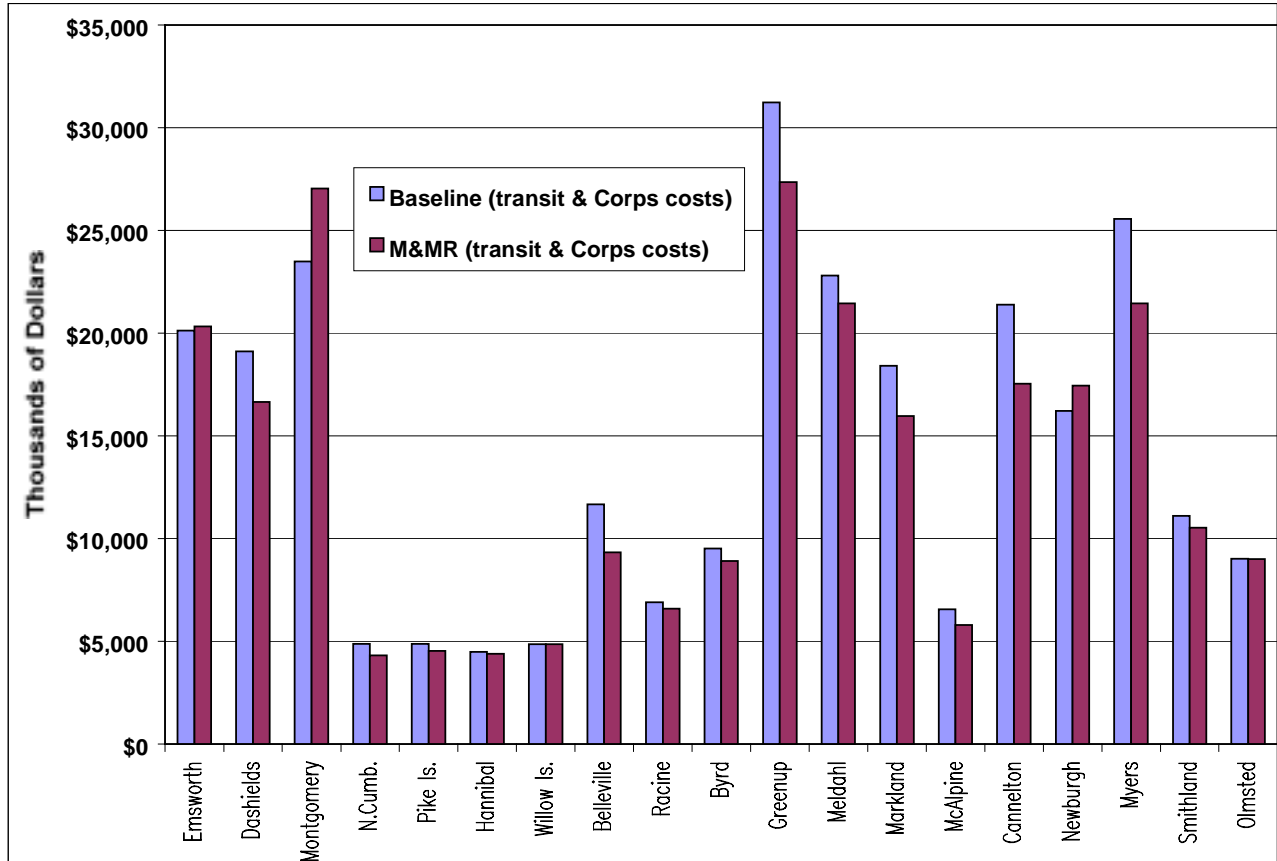
Table 7-4 compares the relative effectiveness of the two WOPC alternatives from an economic standpoint. On a system-wide basis, the M&MR scenario, despite having a higher average annual cost, provides the highest net benefits.

TABLE 7-4
Comparison of Maintenance Scenarios
(2000 – 2060, Discounted to 2008 @ 6.875%)

Without Project Alternative	First Cost	Average Annual Values ('000 \$)		
		Cost	Benefit	Net Benefit
Baseline	\$ 4,919,459	\$ 65,598	\$ 2,639,311	\$ 2,573,713
M&MR	\$ 4,776,018	\$ 72,321	\$ 2,690,257	\$ 2,617,936

These two WOPC alternatives were also compared on a project-by-project basis. Again, the M&MR proved to be the best WOPC alternative at all but three sites (see **Figure 7-3**). The M&MR scenario is selected as the most likely WOPC future for the mainstem Ohio River and is used as a system backdrop when evaluating any project-specific improvement alternative.

FIGURE 7-3
Comparison of Maintenance Cost Scenarios, by Project
(2000–2060, discounted to 2000 @ 6.875%)

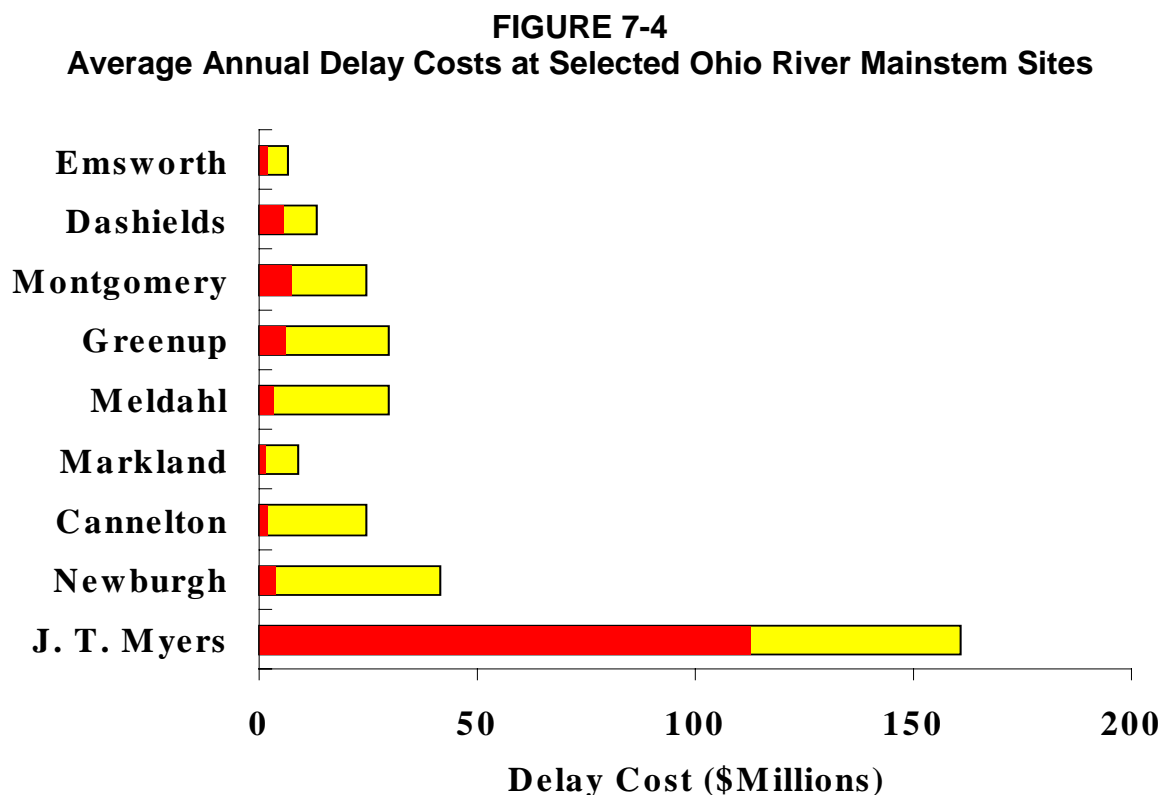


INTERIM SYSTEM NEEDS

As is apparent in the discussion above, developing a most likely Without-Project condition (WOPC) for the entire mainstem Ohio River requires the systemic assessment of condition, capacity and demand. Because analytical tools and databases were just being developed, condition assessment and associated engineering reliability modeling required the greatest effort and exhibited the greatest evolution over the course of the study. Not surprisingly, then, the process of developing this system's current and most likely WOPC future acted to focus study efforts on refining the assessment of needs. Refinements proceeded through three steps: 1)very preliminary, venture-level assessments based upon condition surveys and engineering judgement, 2)concept-level assessments based upon engineering judgement and initial engineering reliability modeling, and 3)feasibility-level assessments based upon final engineering reliability modeling. Design and cost estimates for structural improvements proceeded along a similar path of refinement. Three distinct phases of the economic assessment accomplished these refinements and led to the conclusion that J.T. Myers and Greenup locks and dams needed immediate attention. Each of these three phases is discussed below.

Preliminary Reliability Assessments (Early 1997)

In the first phase of the system analysis, structural condition surveys at each mainstem site assisted engineers in identifying problem components and sites. Engineering judgement based upon these assessments supported preliminary, venture-level descriptions of lock reliability. These descriptions estimated when a major lock component would need to be replaced, how much it would cost, and how many days, if any, a lock chamber would need to be closed in order to effect repairs. Cyclical maintenance needs, a level of maintenance necessary to ensure good working condition for major components and sub-components, were also described in a similar fashion. These preliminary assessments were inputs to early system economic model runs used in evaluating alternative WOPC futures. These runs indicated that projects with Auxiliary chambers too small to handle traffic during closures of the Main chamber would experience high future transit costs (the sum of costs incurred while waiting and while processing through a lock). System economic model runs for the WOPC completed in early 1997 showed very high transit costs at J.T. Myers and somewhat lower transit costs at, in order of magnitude, Newburgh, Greenup, Meldahl, Montgomery, Cannelton, Dashields, Markland, and Emsworth locks and dams (see **Figure 7-4**).



Note: Heavy shading represents delays during normal operation, light shading
Represents delays during closures.

Preliminary With Project Cost Estimates (Late 1997)

The second phase of the analysis focused on improving the performance of the WOPC, incorporating the cost of proposed system improvements, and developing concept-level reliability descriptions. Very preliminary, venture-level designs and costs for structural solutions at all nine sites were used to identify those sites that offered the highest benefits after accounting for the cost of the improvement—the net incremental benefits. This analysis concluded in December 1997 and indicated that the highest net benefits accrued from improving J.T. Myers, Newburgh, Greenup, and Meldahl locks and dams (see **Table 7-5**). However, even as these results were being presented, better reliability information became available that indicated Greenup Locks and Dam might have more serious structural problems than originally thought. This led to the next phase of the system analysis.

TABLE 7-5
December 1997 Concept-level Improvement Plans
Incremental Net Benefits of Concept Plan Implementation
(millions of October 1997 dollars, 7 1/8% discount rate, base year 2008)

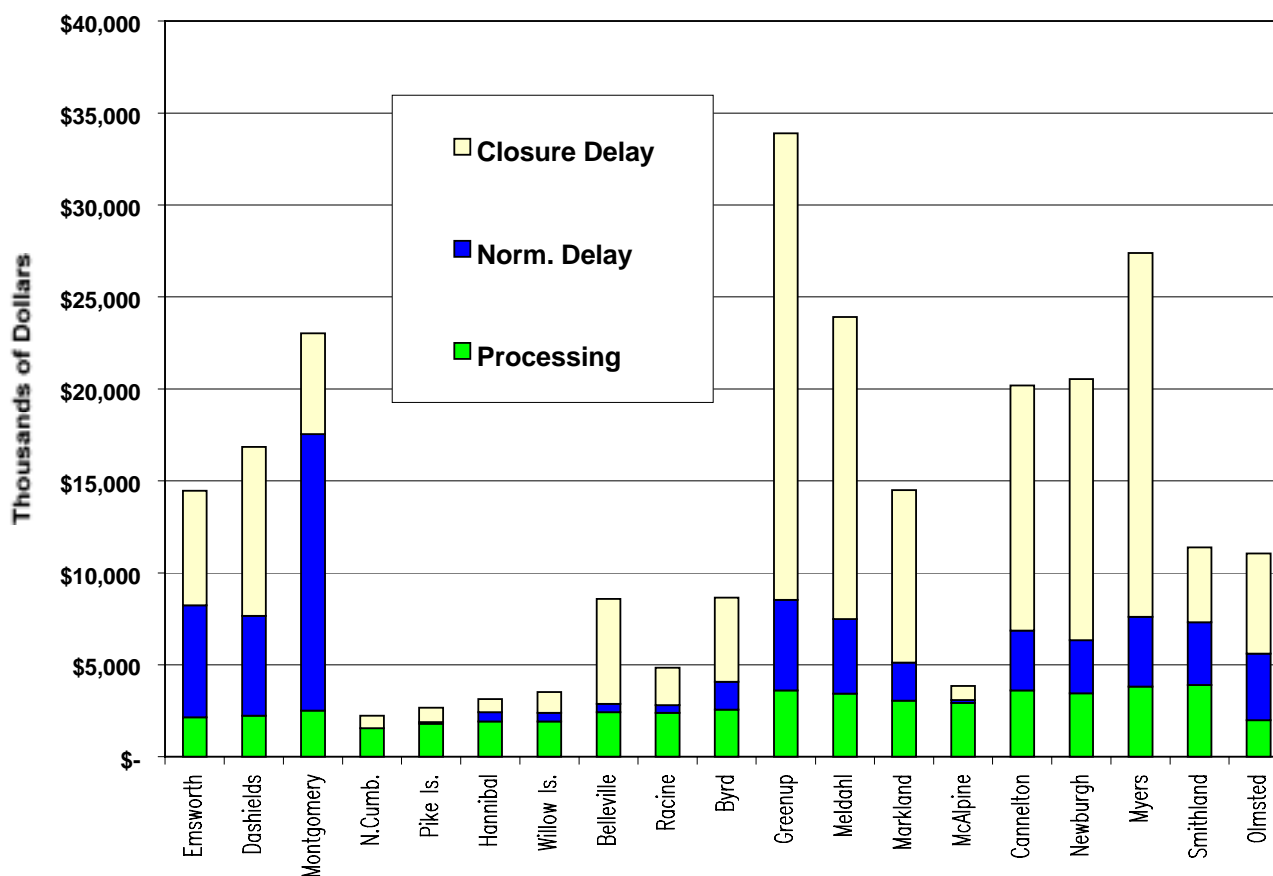
Plan	Incremental Net Benefits
Without Project	---
Plan 2b_1 Myers only	29,030
Plan 2b_2 plus Newburgh	19,351
Plan 2b_3 plus Greenup	14,145
Plan 2b_4 plus Emsworth	1,849
Plan 2b_5 plus Cannelton	10,101
Plan 2b_6 plus Meldahl	13,502
Plan 2b_7 plus Markland	5,782
Plan 2b_8 plus Montgomery	4,508
Plan 2b_9 plus Dashields	3,829
Plan 2b all nine	---

Feasibility-level Assessment (for Early-Action Sites)

The third phase turned study attention to refining the reliability descriptions and cost estimates at J.T. Myers and at Greenup. These two inputs became the focus because of J.T. Myers' extremely high transit costs and Greenup's pressing reliability needs. This phase used

feasibility-level designs, cost estimates, and reliability estimates, and fully explored non-structural alternatives to identify the most likely WOPC on the mainstem Ohio (see "SYSTEM-WIDE WITHOUT-PROJECT CONDITION" above). Figure 7-5 shows that despite implementation of aggressive nonstructural measures, excessive lock transit costs were still projected for several sites, though these transit costs were not as high as those estimated in earlier phases. The largest portion of transit costs on the lower river relates to delay costs experienced during closures of the Main chamber, whether for random minor events (like accidents), cyclical maintenance, or scheduled component replacement. This too proved to be a problem on the upper river at Emsworth, Dashields and Montgomery, along with delays during normal operations. Given the combination of Main chamber closures, Auxiliary chamber capacity shortfalls, and traffic demands, transit costs were projected to be highest at Greenup and J.T. Myers – results consistent with earlier analyses

Figure 7-5
Average Annual Transit Costs by Site (2010-2060)



As a result of the findings of the system analyses, J.T. Myers and Greenup locks and dams were advanced in this interim study. Discussions that follow in **Part A** and **Part B** examine alternative Without-Project and With Project futures for J.T. Myers and Greenup, respectively. **Sections 10** and **13** focus on developing and presenting the most likely Without-Project future condition for J.T. Myers and Greenup locks and dam, respectively. **Sections 11** and **14** will identify and evaluate With Project alternatives capable of addressing the problems and needs suggested by this mainstem system analysis. **Sections 12** and **15** describe the performance of the final plan.

Sensitivity analyses were also performed to test project benefits to key input data and verify the optimum timing of the proposed investments. These sensitivity analyses are discussed in Sections A12 and B12 of the Economics Appendix (Document EC). The timing analysis verifies the prudence of advancing the recommended improvements for J.T. Myers and Greenup in an interim report. When examined individually, J.T. Myers is optimally timed for improvement in the 2008 to 2010 timeframe and Greenup in 2008; however, this analysis needs to be taken one step further. The final test is whether net benefits are maximized by replacing both J.T. Myers and Greenup in 2008 or Greenup in 2008 and J.T. Myers in 2010. As can be seen in **Table 7-6** below, net system benefits are maximized when both projects are improved in 2008.

TABLE 7-6
Optimum Timing for Improvements at J.T. Myers and Greenup
Incremental Benefits and Costs of the Improvement
(millions of October 1999 dollars, 6 7/8% discount rate, base year 2008)

	On Line Date in:	
	2008 1/	2008/2010 2/
Costs	21.0	19.5
Benefits	45.3	42.8
Net Benefits	24.3	23.4
BCR	2.2	2.2

1/ Complete both Myers and Greenup by year 2008.

2/ Complete Greenup by 2008, and Myers by 2010.

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SECTION 8

PUBLIC INVOLVEMENT AND INTER-AGENCY COORDINATION

This section presents a summary of communications with various groups and publics throughout the Ohio River Mainstem System Study, and particularly during the preparation of this Interim Report.

EARLY NAVIGATION AND MARINE INDUSTRY OUTREACH (1992-96)

Lock Capacity/Operations Process Action Teams (PATs)

Both the shipping industry and Corps' technical analysts view the efficiency of lock processing as a prime determinant in overall shipment time and cost. Accordingly, three Process Action Teams (or PATs) were formed during early study efforts to discuss ways to improve vessel processing at the locks – one for each of the three Ohio River Corps' "jurisdictions": Louisville District (mouth to Markland pool), Huntington District (Meldahl Dam to Willow Island pool, and Pittsburgh District (Hannibal Dam to Pittsburgh PA). To facilitate communications, each of these PATs were relatively small groups; the different groups met every 2-3 months over periods between 1994-96.

The Louisville District Lock Capacity PAT met between 1994 and 1995, and consisted of 8-10 representatives from the following groups or companies:

- Corps of Engineers' analysts, planners, and lock personnel
- Ingram Barge Company
- METCO
- Western Kentucky Navigation Co.
- American Commercial Barge Lines

The Louisville District PAT decided its focus would be low-cost or “process” improvements – improvements involving minimum cost or “red-tape” to implement. It developed a survey for lock users, which was distributed to all lock “customers” during December 1994-January 1995. Time was spent in early 1995, then, to organize and tabulate survey results. A report was prepared in early 1997 summarizing the work and findings of the PAT, entitled “Process Action Team—Lock Capacity”. The report’s recommendations were primarily of a routine operational nature, and have no direct bearing on the recommendations of this Interim Report.

The Huntington District coordinated a similar lock-users survey through its Waterways Advisory Committee of Huntington District (WACHD). In the Huntington District, the survey was mailed to all parties listed in the Notice to Navigation Interests. Currently, this mailing list consist of 250 to 300 addressees, including towing companies, shippers, receivers, river docks, power plants, and river-side landowners. The survey was also handed out to all vessels as they passed through the Huntington District locks over a two-month period. Again, the survey’s results were primarily of benefit to the Corps’ lock-operations elements, and did not involve any substantive suggestions for capital expenditures.

The Pittsburgh Waterways Association, in partnership with the Pittsburgh District, formed a Lock Capacity PAT to solicit input from commercial users, evaluate the responses and make recommendations of actions needed to improve or correct issues raised by the users. Membership in this PAT consists of numerous representatives of the towing industry, terminal owners, and routinely includes groups such as DINAMO and the Port of Pittsburgh Commission. In November-December 1996, the Pittsburgh District sought to obtain current information related to concerns of navigation industry for this study. It conducted a survey of towing industry personnel as they passed through the locks along the Ohio River within the Pittsburgh District. The survey form used was based on that the developed by the Louisville District Lock Capacity PAT as described above. The survey form was also distributed to addressees on the Navigation Notice list and posted on an Internet site. Seventeen forms were returned to the District with one or more comments. As well as being considered for this study, all comments were presented to the Pittsburgh District Lock Capacity PAT for consideration and possible implementation. The PAT classified each comment in one of four categories (Immediate Action, Long Term Project, Further Study Required, or No Action Required). Most comments involved day-to-day lock-operation matters, most notably dealing with communication between the Corps and tows, and will not be directly considered through the ORMSS process. However, the Pittsburgh District or others may implement a few of the suggested measures independently of this study.

Other Pittsburgh-area Coordination

In addition to PAT activities described above, early Ohio River Mainstem System Study (ORMSS) coordination within the Pittsburgh area consisted of two meetings. One involved a presentation before the Waterways Association by the Pittsburgh District Plan Formulation team member at the July 1996 meeting in Pittsburgh. Objectives for ORMSS were described and needs at the three Upper Ohio projects described in general terms. The second meeting was held in Wheeling, West Virginia with federal and Pennsylvania, West Virginia, and Ohio environmental resources agencies. Discussions led by Environmental team members focused on

general environmental objectives. Input was requested from the agencies concerning priorities for needs and improvements in and along the Ohio River.

As discussed in Section 7, resolution of Pittsburgh-area problems and needs have been found secondary in priority to those of Myers and Greenup Locks. Accordingly, resolution of upper-Ohio area problems has been deferred to a later Report.

ENVIRONMENTAL OUTREACH

Interagency Coordination

Starting in October 1996, inter-agency Environmental Team Meetings (which included resource-agency representatives from 6 states, the US EPA, and the US Fish & Wildlife Service) were held every 3-4 months at various sites. These meetings considered both long-range planning issues for the Ohio River Mainstem as a whole, as well as for plans to improve Myers and Greenup Locks.

In addition, site visits were conducted at Greenup L&D on April 15, 1999, and at Myers L&D on February 18, 1999. The purpose of these site visits was to show interested state agency representatives the layout of the proposed sites and the natural resources that could be potentially affected by any improvements.

Details on interagency coordination may be found within the Environmental Impact Statement (EIS).

Development of an Ohio River Eco-System Restoration Program

In 1999, the environmental team met a total of six times with various state resource agencies and other public entities to discuss ecosystem restoration, sometimes including representatives from firms that ship or tow products on the waterways. These included two Oversight/I.P.R. meetings involving many Oversight Committee and plan formulation, economics, engineering, as well as environmental functional team members. The U.S. Fish and Wildlife Service was represented at each of these meetings, led by the Tennessee office which attended all sessions.

In late January, the Corps tasked the states to identify and prioritize projects for consideration in this study. At that time a vision statement and study goals were developed. Lists of projects were requested within 30 days. At the March Oversight Committee meeting, presentations were provided by Corps personnel on various topics including program definition, the types of projects that were likely to be recommended, and the study schedule. At a follow-up meeting in late March, a detailed list of 221 potential restoration sites was presented. The states were asked to pare down their respective lists to the top three projects to be studied at full

feasibility level. The Oversight Committee was briefed as to the number of sites (222) recommended by the five participating states (IL, IN, KY, OH and WV) at the June 1999 meeting. Also at this meeting, a strategy for two different levels of study and types of projects was presented, as well as a schedule to complete the work. The environmental team met with agencies in late July to discuss the study schedule, report issues and planning, design and construction issues, as well as a strategy for completing an Environmental Impact Statement for the ecosystem restoration program. Corps members provided a status report of study activities in October. A list of participants at each of these meetings is shown below in Table 8-1.

TABLE 8-1. Key Participants at Ecosystem Meetings in 1999

Date(s) / Meeting	Participants
January 26/27, Environmental Team Meeting, Parkersburg, WV	U.S. Fish And Wildlife Service (IN, OH, TN and WV, and Ohio River Islands National Wildlife Refuge); U.S. Environmental Protection Agency-Region V; IL and WV State Departments of Natural Resources; KY Department of Fish and Wildlife Resources; Corps' Pittsburgh, Huntington & Louisville Districts; Corps' Contractors (Mangi Environmental and Parsons Engineering Science)
March 3, Oversight Meeting, Louisville KY	U.S. FWS. (TN) Ohio River Fisheries Management Team (ORFMT); Association For The Development of Inland Navigation in America's Ohio Valley (DINAMO); American Rivers Association
March 30/31, Environmental Team Meeting, Ashland KY	U.S. FWS (IN, OH, TN, WV, and Ohio River Islands National Wildlife Refuge); IN, IL and WV State Depts. of Natural Resources; Ohio River Sanitation Commission (ORSANCO); Corps Division and Districts; and Corps Contractors
June 2 Oversight Meeting, Ashland KY	U.S. FWS (TN), KY Dept. of Fish and Wildlife Resources, DINAMO, Navigation Industry, and Corps
July 21/22 Environmental Team Meeting, Evansville Indiana	U.S. FWS (IN, OH, TN and WV); IL and IN Departments of Natural Resources; KY Dept. of Fish and Wildlife Resources; IN Div. of Wildlife; IN Natural Resource Conservation Service; Indiana Department of Environmental Management; Corps, and Corps contractors.
October 14 oversight Meeting, Pittsburgh PA	U.S. FWS (TN), DINAMO, Navigation Industry and Corps.

SCOPING MEETINGS

Ohio River Mainstem System Study (ORMSS) public workshops were held in November 1998 in each of three metropolitan areas representing the lower, middle and upper reaches of the Ohio River. Three nearly identical workshops took place from 12:00 noon to 8:00 p.m. over a one-week period -- in Evansville, IN on November 17, 1998; in Huntington, WV on November 19; and in Pittsburgh, PA on November 24. There were two primary purposes for these workshops:

- to obtain input from the public-at-large on future needs for Ohio River navigation and for environmental restoration opportunities along the River; and
- to fulfill (partially) requirements of the National Environmental Policy Act which call for such public scoping meetings.

A Public Notice announcing the meeting and describing the study strategy and schedule was mailed to approximately 3200 agencies, industries, and individuals. A total of eighty individuals attended the three sessions (approximately 27 at each).

Each session consisted of an open display area with three display areas – for (1) Plan Formulation and Engineering, (2) Economics, and (3) Environmental issues. Each display area was manned by ORMSS study team leaders, to answer questions and discuss issues.

Supplementing these displays was a looping 40-minute audio-visual slide show that discussed the history of the Ohio River navigation development, the ORMSS study schedule, and current problems – i.e., Myers Lock, Greenup Lock, and the three upper Ohio locks with old, small 600' Main chambers.

Both the Public Notice and meeting generated several commenting letters. Informative comments were obtained at all sessions, and were fully considered in preparation of this report. Environmental comments in response to the Scoping meetings are addressed in the Environmental Impact Statement (EIS).

OTHER COORDINATION WITH STATES

In addition to coordination with Ohio River states' resources agencies as described previously, other miscellaneous coordination was handled through four channels:

- frequent interaction with Mainstem states' resources agencies (as discussed above);
- representation by states' development and transportation groups at various In-Progress Review Meetings;
- DINAMO (the Association for the Development of Inland Navigation in AMerica's Ohio Valley), whose board and executive committee include government and port-commission representatives from Indiana, Ohio, Kentucky, Pennsylvania, and West Virginia.
- fact sheets, reports, and other memorabilia to governors – at key study milestones.

ANNUAL CORPS / COAST GUARD / MARINE INDUSTRY FORUM

The Inland Waterways Conference is an annual conference at which the US Army Corps of Engineers, US Coast Guard, and commercial shipping interests share the latest information on projects, procedures, and upcoming events that affect inland waterways users. Typically the two-day event is arranged so that the Coast Guard presentations are held one day, and Industry and Corps programs are held on the second. These conferences focus on Ohio-Mississippi River Valleys' navigation issues, and are generally held in alternating years in St. Louis and the next in Louisville or greater Cincinnati.

Over the last three years, representatives for the Corps have provided briefings on the status of ORMSS studies. In 1999, the ORMSS Project Manager provided an update of the overall study status, focusing on efforts to analyze the need for lock improvements at J.T. Myers and Greenup Locks and Dams. Status of the Ecosystem Restoration and the overall system analysis was also provided at that time.

RECENT COORDINATION LEADING TO INTERIM REPORT PREPARATION

In the first quarter of 1998, the Pittsburgh District responded to inquiries from government and private parties who reacted to District engineering investigations (and subsequent newspaper accounts thereof). At the time, the Engineering team was reviewing alternatives and impacts to marine facilities that would result due to considered changes to the Dashields and Montgomery pools. Such changes are being considered as potential modernization plans for the Upper Ohio River. The Pittsburgh District also met with DINAMO and representatives from navigation several times to discuss Upper Ohio alternatives, including one meeting during a boat tour of the river and locks.

In March 1998, the Louisville, Huntington, and Pittsburgh Districts mailed study fact sheets to Congressional interests and to various state and local government and key industry members. These fact sheets focused on the high potential for lock modernization at Greenup and Myers Locks and Dams. There were no direct response letters received by any District office to these mailings, although a few U.S. Congressional offices requested and received briefings on ORMSS study progress.

Since that time, In-Progress Review (IPR) meetings have become more frequent, often coinciding with or following quarterly study Oversight-Group conferences. A history of IPRs is presented below.

In-Progress Review Meetings

ORMSS study management requires frequent intra- and inter-team conferences and telephone conferences. The ORMSS Oversight Group (selected LRD and executives) review study progress through monthly telephone conferences and quarterly face-to-face conferences. These quarterly Oversight Conferences have often followed, or been held in conjunction with, broader In-Progress Review meetings (IPRs), in which a broader forum is invited, including:

- Corps Headquarter staff;
- U.S. Fish and Wildlife Service partners;
- Mainstem-border states' fish and wildlife resource agencies;
- Marine industry partners;
- Electric Power and other industry officials;
- State and other Federal officials.

A summary log of the ORMSS IPRs, attendees, and significant issues is provided in Table 8-2.

Ongoing Coordination by the Waterways Advisory Committee of Huntington District (WACHD)

The Huntington District has had a continual running dialogue with marine industry groups through its the Waterways Advisory Committee of Huntington District (WACHD). Prime examples of interaction with the WACHD are as follows:

- Meetings to discuss possible locations where additional mooring facilities could be used to enhance or improve the lockage conditions at various locks. This information was combined with similar information from Louisville and Pittsburgh Districts to generate a working document entitled *ORMSS Small Capital Improvements Study, Mooring Facilities, Engineering Designs and Costs, 8 February 1999*.
- After the quarterly I.P.R. conference of June 1999, the WACHD wrote a letter to the Huntington District officially requesting that any mooring facilities considered for downstream of Greenup L&D be fixed-cell because of safety concerns for their crews.
- Marine industry also arranged a boat trip for the Greenup Design Team to demonstrate the approach problems and concerns they had with the Greenup Lock.
- A meeting was held on 9 November 1999 during which the Greenup Design Team explained the proposed 600 foot lock extension plan in detail. Suggestions for improvement in the designs, timing of closures, and other items directly impacting the towing industry were finalized.

TABLE 8-2. Summary of In-Progress Review Meetings (IPRs)

Date	Location	Major Agenda Topics	Those Present (other than Team & Oversight Members)	Actions (if any)
22-May-97	Cincinnati OH	<ul style="list-style-type: none"> Traffic Forecasts Maintenance and Major Rehab Small-Scale Improvements Large-Scale Improvements Environmental Studies/Coordination 	<ul style="list-style-type: none"> Corps of Engineers HQ: (Planning / Engrg) Waterways Experiment Station DINAMO Freight Industry reps. US and states' F&W reps. Upper Mississippi / Illinois W.W. Team 	<ul style="list-style-type: none"> Nav. Industry Expressed Willingness to partner in Environmental Restoration. Corps to Contact Nav. Industry re Vessel Mooring Needs. Nav. Industry favors Extension (not a 3rd lock) Ohio R sites. Traffic Forecast Methodology OK'd by HQ.
14-Apr-98	Pittsburgh PA	<ul style="list-style-type: none"> Without-Project scenarios Large-scale Improvements Small-scale Improvement Ideas USFWS Perspectives Ecosystem Restoration 	<ul style="list-style-type: none"> Corps of Engineers HQ: (Planning / Engrg) Study Contractors Pennsylvania Ports Assoc. DINAMO Freight Industry reps. US and states' F&W reps. American Electric Power (AEP) 	<ul style="list-style-type: none"> Consensus on two basic Without-Project Condition (WOPC) scenarios
3-Mar-99	Louisville KY	<ul style="list-style-type: none"> Myers-Greenup Improvements Ecosystem Restoration & Status Interim Report Status 	<ul style="list-style-type: none"> Corps of Engineers HQ: (Planning / Engrg) Study Contractors DINAMO Freight Industry reps. US and states' F&W reps. 	<ul style="list-style-type: none"> Preliminary Interim Alts--screened out all third (additional 1200') lock plans. Distributed 20% DRAFT skeleton report. 6-state Eco-System Restoration team has identified over 220 potential sites.
2-Jun-99	Ashland KY	<ul style="list-style-type: none"> Screening of Final Plans Interim Report Status Ecosystem Restoration Status Overall ORMSS Status 	<ul style="list-style-type: none"> Corps of Engineers HQ (Planning) Freight Industry reps. US and Kentucky F&W reps. 	<ul style="list-style-type: none"> Waterway Industry reps. OK with final concept for lock extension.
14-Oct-99	Pittsburgh PA vicinity	<ul style="list-style-type: none"> Overall ORMSS Status E-D-M (next?) Interim USFW problem with ORMSS interims--"piece-mealing" 	<ul style="list-style-type: none"> US and Ohio F&W reps. Freight Industry reps. Electric Utility, Coal, and Petrochemical Industries' Reps. Ohio Dept. of Development Port of Pittsburgh Commission 	<ul style="list-style-type: none"> F&W reps. expressed difficulties with additional Interims (following this report) Nav. Industry Reps. preferred an interim rpt. approach for upper Ohio R issues. Freight Nav. Industry leaders agreed to meet with USFW to share info on sailing-line problems & navigation in sensitive areas.

DRAFT Interim Report Coordination / Review

The DRAFT version of this Interim Report (dated December 1999) was widely disseminated in January 2000 to numerous agencies and to the general public (on request). Public meetings were held in Greenup, KY on February 9, 2000 and at Mt. Vernon, IN on February 14, 2000 to discuss the findings in the draft Interim. Pages in the Main Report and in Appendices that have been revised during or as a result of the draft's coordination are generally marked "Revised April 2000" (or similarly) near the page number. (Changed pages in the EIS, however, were not explicitly marked due to the many revisions / clarifications that were made throughout the EIS). Coordination of the December 1999 Draft Interim Report is discussed more fully in **Section 16**.

SECTION 9

PLAN FORMULATION (GENERAL)

The previous section described existing conditions throughout the Ohio River Mainstem, identified system-wide problems, and identified the Myers and Greenup sites as priority locations for improvements. Before discussing problems, needs, and solutions for the Myers and Greenup sites in more detail (in Sections 10-13), this section introduces methods for plan formulation, and provides background on innovative lock-improvement design initiatives which have been undertaken by the Ohio River Mainstem Systems Study (ORMSS).

METHODOLOGY AND GUIDELINES

The plan formulation process encompasses a sequence of steps designed to insure full consideration of alternatives in developing a recommendation for improving locking conditions at Myers and Greenup L & Ds. Alternative plans were formulated and evaluated in a multi-stage process with increasing levels of detail. In preliminary screening, a broad range of alternatives were considered in order to identify potential measures that would make future locking conditions at Greenup more efficient. Options that were found to be practical and reasonable in overall development costs were carried forward to the final screening.

The Water Resources Council's Principles and Guidelines (P&G) directives have two major stipulations: (1) the recommended plan must have system incremental benefits in excess of incremental cost, and (2) the recommended plan should provide the maximum net economic benefits to the Nation. The plan that provides maximum net economic benefits is referred to as the National Economic Development (or NED) plan. In addition, the Water Resources Development Act (WRDA) of 1986 (PL 99-662) stipulates that one-half of the construction cost of inland navigation project be paid from the Inland Waterway Trust Fund. Therefore, any recommended plan must have the approval of the Waterway Users' Board, which manages the trust fund.

DEVELOPMENT OF LOWER-COST LOCK STRUCTURAL IMPROVEMENTS

From the beginning of the ORMSS, much work has been undertaken to re-think typical Corps of Engineers lock design, and to ascertain that structural expansions or replacement locks include only those features essential to the safe and expeditious functioning of the locks. Much

of this design work was done simultaneously with other early economics and plan formulation tasks – since it was believed that the cost estimates for such innovative lock designs or lock modifications would largely influence the selection of final plans – and indeed it has. This section provides an overview (history) and documentation of these design iterations.

This work can be split into three phases:

- (1) **Early lock design and feature reviews** -- largely undertaken by the Louisville District Design Branch, with input from HARZA Engineers, INCA Engineers, and the Corps' Innovative Design Task Group. At this time, 1993-94, the study was focused largely on improvements for the Myers, Newburgh and Cannelton sites only. (Later, the Chief of Engineers with the consent of Congress directed the Lakes and Rivers Division, formerly Ohio River Division, towards a broader study of the entire Mainstem.)
- (2) **Wall Design and Empty-Fill Systems** – the 3 Ohio River Districts' Design groups worked jointly with Waterways Experiment Station experts and INCA and Black & Veatch Engineers in costing out various promising lock extension and new-chamber layouts, along with various empty-fill configurations for the new layouts. These designs would be useful for lock expansions at any of the Ohio River locks that were built during the 1954-79 Ohio River "Modernization" program—those locks which now have one 1200' and one 600' chamber. The Pittsburgh District also reviewed various layouts for the 3 oldest Ohio River structures—i.e., Emsworth, Dashields and Montgomery Locks.
- (3) **Final Design Refinements** – as it became clear that the greatest immediate needs were at the J.T.Myers and Greenup sites, work focused on refining plans for extending the existing Auxiliary (600' long chambers) at these two sites, through the vehicle of this Interim report.

The following briefly summarizes the design reviews that took place over these three phases.

(1) Early Lock Design and Feature Reviews

Starting in 1993, even before the Project Study Plan was formally approved, study efforts focused on improvements at the "lower river" locks – since previous traffic studies indicated greatest growth in this area. Hence, early multi-disciplinary design brainstorming focused on needs at the Myers, Newburgh and Cannelton Lock and Dam sites. However, these early lock concepts were conceived so as to be adaptable to any of the 15 Ohio River structures built during the 1954-79 "Ohio River Modernization" program (the 15 contiguous L&Ds from New Cumberland downstream to J.T. Myers). The Louisville District Plan Formulation team, together with the Louisville District Design Branch, spearheaded these early efforts.

This early work can be sub-divided into two sub-phases are follows:

(1A) Review of Lock Components

The Louisville District formulators, economists, Operations officials, and designers worked with HARZA Engineers of Chicago, IL – a large experienced design contractor with international experience on large civil-works projects. This team began with a complete review of lock “parts” or components, such as:

- different wall types, everything from sheet pile cells to earthen or “rubble” lock walls;
- different gate types – everything from standard steel-girder miter gates to inflatable rubber gates.
- Empty / Fill System.

The team compiled its review of different components into a report entitled *Uniontown / ORMS Low Capital Cost Lock Alternatives (DACW27-92-D-0010)*.

(1B) Early Layouts

After the team reviewed the pros, cons and costs of different features, in 1994 HARZA started putting these ideas together into various rudimentary layouts, and costed these layouts. Although these layouts included various wall designs, including roller-compacted concrete (RCC) and earthen or rubble-mound walls, most of the designs focused on three designs:

- extending the existing 110’ wide x 600’ long Auxiliary chambers to a 1200’ length;
- constructing a new (third) chamber, 110’ wide x 1200’ long, at the Ohio River sites. The third locks would be constructed land-side of the existing two chambers where space permitted, although river-side or mid-river (thru-the-tainter-gates) layouts were also explored for some sites, such as Cannelton, where further land-side development would be difficult.
- constructing a new (third) chamber, 110’ wide x 1200’ long, in the center of the river, through a tainter gate section(s), using float-in construction. Because of the depth of the river and the requirements to build both left and right walls and to replace the lost tainter gate capacity, this concept was screened out due to high costs.

HARZA produced reports on these layouts, including drawings and preliminary cost estimates, based on site conditions at Myers (formerly named Uniontown Locks), Newburgh and Cannelton Locks. These data are reported in:

- *ORMSS Design & Cost Screening of Lock Expansion Alternatives – Uniontown L&D*
- *ORMSS Design & Cost Screening of Lock Expansion Alternatives - Newburgh L&D*
- *ORMSS Design & Cost Screening of Lock Expansion Alternatives – Cannelton L&D*

(2) Wall Design and Empty-Fill Screening

By 1995 it became clear that the ORMSS needed to focus on the long-term needs and maintenance of the **entire** Main Stem infrastructure — from Emsworth L&D downstream to the mouth of the river at Cairo, IL. The 3 Districts hired a new contractor, INCA Engineers of Seattle, WA. INCA has had a lot of experience with floating wall construction at Bonneville L&D, and with major earthworks --- INCA did much design for the reconstruction of

Interstate-90 which cuts thru the Seattle area. Later, Black and Veatch Engineers were also hired to help complete analysis of alternatives for the Greenup L&D site.

A multi-disciplinary team from all 3 districts, plus experts from the Waterways Experiment Station (WES) were assembled. Eventually, this brain-storming team involved representatives from all the following:

- Corps Innovative Design Task Force;
- INCA Engineers (Seattle) and their underwater and construction sub-contractors;
- Black & Veatch Engineers (Overland Park, KS).
- 3 Ohio River Corps Districts and Division design and hydraulics experts;
- Ohio River Division and Districts' Operations and Maintenance experts;
- Economics team, Navigation Center (LRH-NC), and lock traffic control experts;
- Plan Formulation leaders;
- Waterways Experiment Station model experts, including:
 - fixed-bed navigation and approach model experts
(Dr. Daggett and Ron Wooley, now retired, and Howard Park);
 - Hydraulic Structures experts (John George, now retired, and John Hite).

The above group (or portions thereof) met for various brainstorming sessions. A particularly useful and well-organized workshop was held at INCA offices, involving most of the above, during the week of 18-22 March 1996. A report on this workshop was produced, plus supplements providing data on a few optional lock layouts:

- *ORMSS Workshop Documentation, March 18-22 1996, DACW27-95-C-0126*
- *ORMSS Workshop Documentation, Supplement #1 Alternative 600C Report
August 29, 1996, DACW27-95-C-0126*
- *ORMSS Workshop Documentation, Supplement #2 Alternative 600D Report,
September 27, 1996*

These workshop documents jump-started a year or two of more extensive investigations. By this time, the team had resolved that, for most Ohio River sites, float-in or “lift-in” pre-fabricated concrete wall sections were the most cost-efficient means of most new Ohio River construction, whether for:

- extension sections,
- third locks for the 1954-79 era “modernized locks”,
- or new chambers for the aging Emsworth, Dashields and Montgomery L&Ds near Pittsburgh.

Important working documents produced during this time-frame included:

- *Report - ORMSS Prepare Conceptual Design for Emsworth L&D, Ohio River,
100% submittal (DACW57-D-0003, Del.O.# DV01)*
- *Report - ORMSS Prepare Conceptual Design for Montgomery L&D, Ohio River,
100% submittal (DACW57-D-0003, Del.O.# DV03)*
- *Report - ORMSS Prepare Conceptual Design of Dashields L&D, Ohio River,
100% submittal (DACW57-D-0003, Del.O.No. DV03)*

(3) Final Design Refinements

From 1998 to the present, the design/formulation team efforts have focused on two key areas of refinement:

- construction methods and sequences; and
- refinement of cost-efficient supplementary empty-fill systems (especially for the extended Auxiliary chamber concepts).

INCA produced a report in 1998 entitled *ORMSS, 100% Submittal, constructability and Cost Estimate (Analyses) for Prototype Alternatives (DACW27-95-C-0126)* which costed layouts for 9 different empty-fill configurations. These configurations are shown in Figures 7-1 and 7-2. Following this comparison, the formulation-level design/ formulation team resolved in favor of configurations 600C2 for Myers, 600C4 for Greenup, and 1200B1 for a third lock at either site. Some of the other configurations in Figures 7-1 and 7-2 might be useful later for sites other than Myers and Greenup. As is discussed in the next section, the third-lock configuration (1200 B-1) was eventually screened out of the array of final plans – it cost too much yielding no significant incremental benefits.

Although not shown in Figures 7-1 and 7-2, by 1997 the multidisciplinary design / formulation team, with significant expert advise from the Waterways Experiment Station, included various common guard and guide wall extensions in all the improvement plans. These guide and guard wall extensions, using primarily pre-fabricated, floating concrete “box” structures, would allow full use of both chambers in the future, while minimizing tow interference. A sketch showing the common wall extensions for the Auxiliary chamber extensions plans, overlaid on the J.T. Myers site, is shown in Figure 7-3. Figure 7-3 also shows configuration 600 C-2 in more detail, and provides a color-key for plan drawings used in Sections 8-14.

During later (Post-Authorization) Preliminary Engineering and Design (P.E.D.) work, a more efficient empty-fill system may be found workable—but P.E.D.-level physical modeling at WES is required to fully determine the workability of these systems. It is not believed, however, that the choice of the precise empty-fill configuration greatly affects the cost or the selection of the recommended plan in this Interim Report.

Design efforts since late 1998 have concentrated on completion of Engineering Technical Appendices for each of the Myers and Greenup Sites (these are appendices to the Interim Report, now under development) -- so as to produce reliable Feasibility-level layouts and M-CACES cost efforts for the two sites. Final layouts are discussed in Parts “A” and “B”, and large drawings are provided in the two Engineering Site Appendices (Documents ED-1 and ED-2).

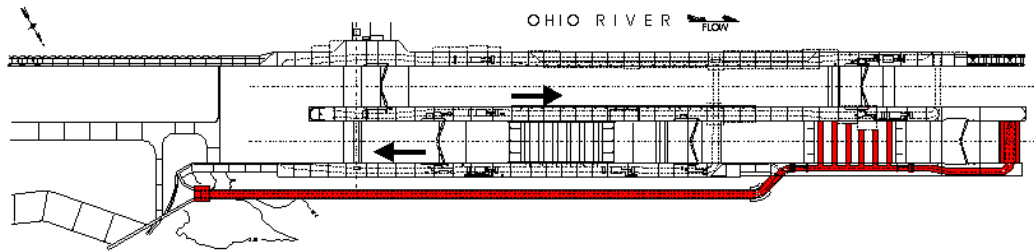
Innovative navigation lock design refinements over the past 3-4 years have been aided by various Corps research and development initiatives, particularly the Regional Navigation Design Team (RNDT) involving engineers from the Lakes & Rivers Division (LRD) and Mississippi Valley Division (MVD). This process has also been aided by the Innovations for Navigation Projects Research and Development program.

Ohio River Main Stem Systems Study

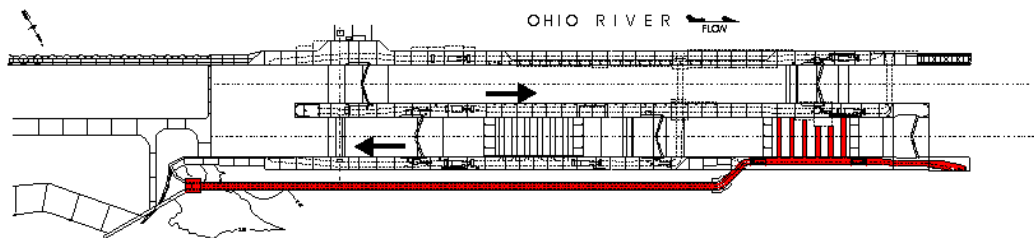
Sheet 1 of 2

Early 1998 Design Refinements

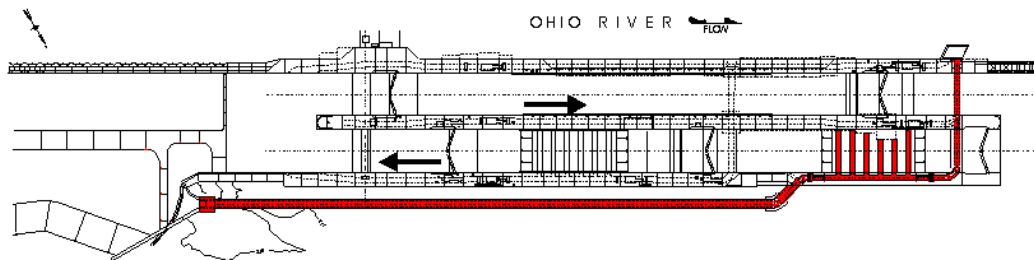
**Prototype Empty-Fill Option / Layouts for
Ohio River 1954-79-era Locks
(based on J.T. Myers site)**



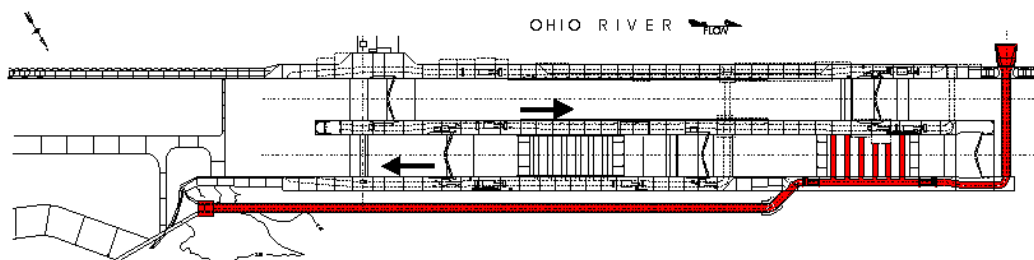
Alternative 600 C-1 - 600 Foot Lock Extension



Alternative 600 C-2 - 600 Foot Lock Extension

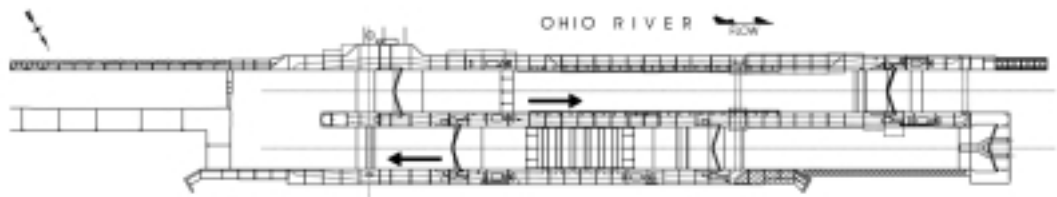


Alternative 600 C-3 - 600 Foot Lock Extension

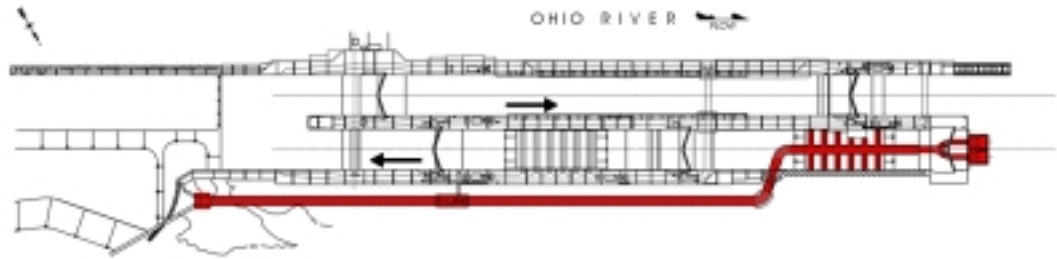


Alternative 600 C-4 - 600 Foot Lock Extension

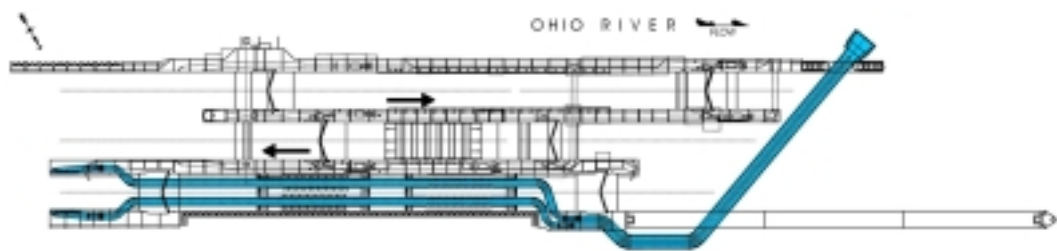
Figure 9-1



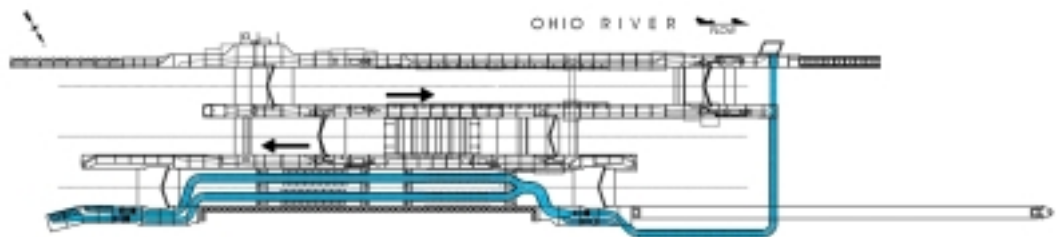
Alternative 600 B - 600 Foot Lock Extension



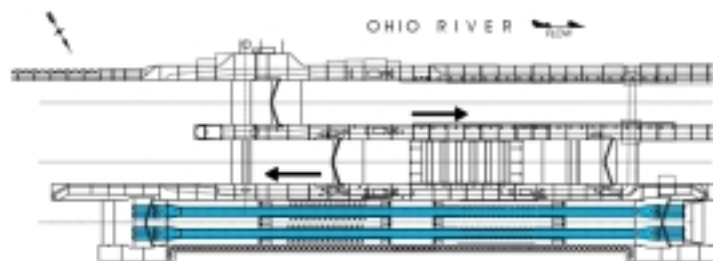
Alternative 600 D - 600 Foot Lock Extension



Alternative 1200 B-1 - New 1,200 Foot Lock



Alternative 1200 B-2 - New 1,200 Foot Lock



Alternative 1200 B-3 - New 1,200 Foot Lock

Figure 9-2

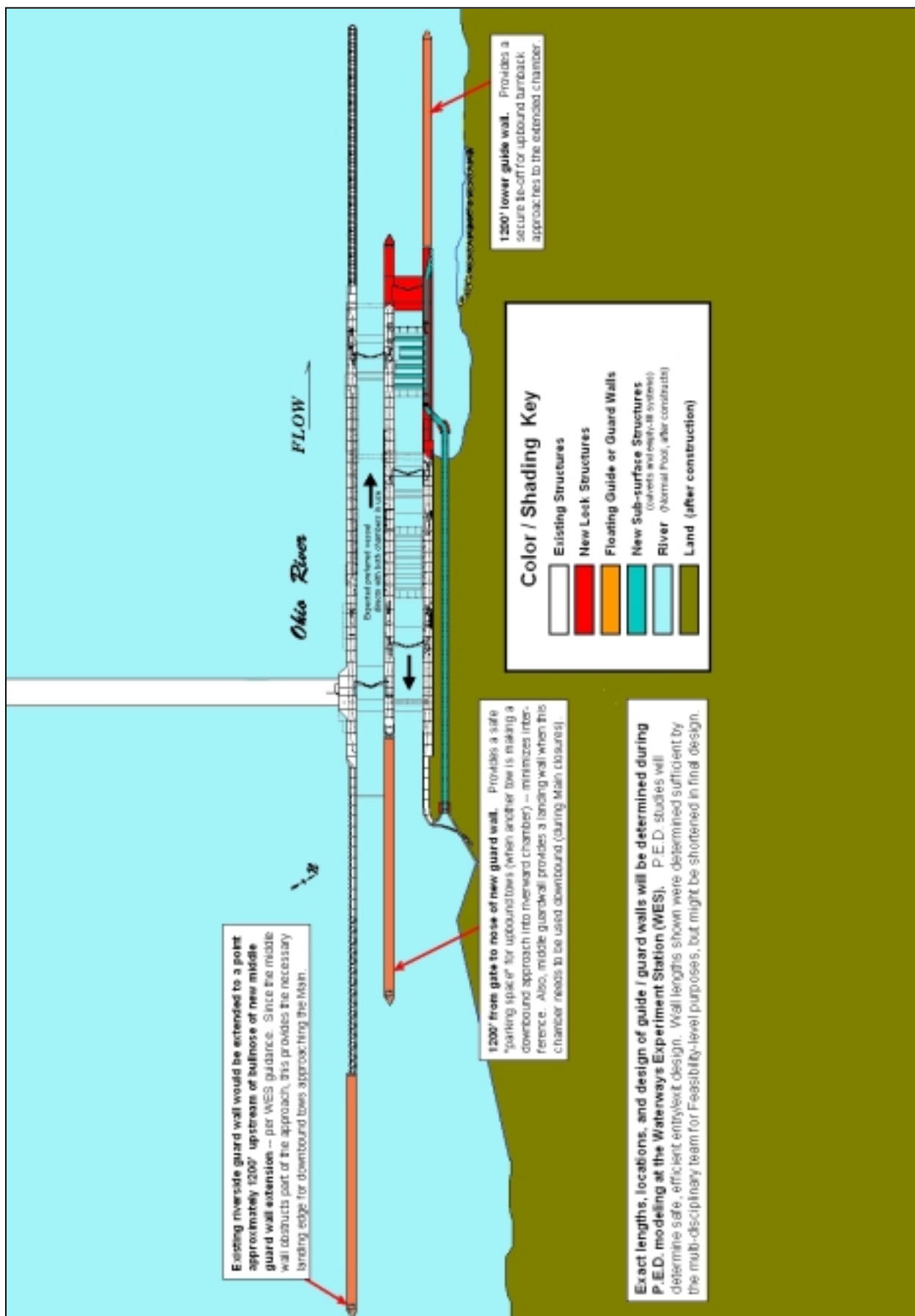


FIGURE 9-3. Prototype Auxiliary Chamber Expansion showing Guardwall / Guidewall layouts for typical Ohio River locks that have a 600' Auxiliary chamber.

Formulation

Part A

Plan Formulation data specific to the J.T.Myers Lock & Dam Site

Section 10:
Myers Without-Project Condition

Section 11:
**Identification of Alternative
Improvement Plans**

Section 12:
Evaluation of Final Plans

SECTION 10

J.T. MYERS L&D

WITHOUT-PROJECT CONDITION

Section 7 established the need and priority for improvements at J.T. Myers L&D (as well as Greenup L&D) on the basis of system-wide Without-Project evaluation. This section provides specifics on:

- problems and needs at Myers (the existing condition);
- determination of the most-likely future Without-Project Condition for the Myers site.

EXISTING PROJECT AND THE WITHOUT-PROJECT CONDITION

Project Description

Myers Locks and Dam has been in operation since 1975. Even though it has never undergone a Major Rehabilitation, the structure is in fairly good condition and should continue to provide navigation service over the period of analysis with proper operation and maintenance and a moderate amount of major maintenance work. The costs for rehabilitation of the dam have been included in the Without-Project condition and are summarized below. The detailed schedule and cost estimate for the maintenance and rehabilitation work are presented in Section 7 of the General Engineering (GE) appendix.

Myers Locks and Dam has a 110' x 1200' Main chamber and a smaller, 110' x 600' Auxiliary chamber. The Main chamber alone has sufficient capacity to handle current traffic levels, but the Auxiliary by itself does not. Therefore, when the Main chamber is closed for whatever reason, significant delays occur at the project. In order to minimize delays, aggressive measures are implemented during Main chamber closures, including a self-help program of extracting and repositioning barges during multi-lockage operations. Additionally, the Corps and industry work together to schedule closures within the year so as to minimize the costs for each. This pre-planning allows industry to re-schedule shipments around the closure period to the greatest practical extent.

Major Maintenance Requirements

The Most Likely Maintenance and Major Rehabilitation (M&MR) scenario was selected as part of the system-wide most likely Without-Project condition future in Section 7. This scenario was compared with a Fix-as-Fail maintenance scenario. The M&MR demonstrated the highest net benefits of the two scenarios. The following discusses the engineering and economic assessments for each of Myers' individual components, and summarizes the findings that supported the selection of the M&MR as part of the Without-Project condition.

Major Maintenance

Structural Reliability Assessment. The Engineering Reliability analysis is discussed in detail in the General Engineering Appendix. Hazard values and consequences were developed for each component, the consequences being chamber closure duration, if any, and cost of repairs. This information is presented in the form of an event tree for each component at each chamber. **Table 10-1** summarizes the Engineering Reliability results for J.T. Myers by lock chamber. These replacements can be made either as the component fails or as part of a planned replacement. Of the ten major components, six will need to be replaced in the Main chamber and five in the Auxiliary chamber. Due to the spread of the component replacement timing, it was determined that it was best to replace each component separately when economically justified, as opposed to bundling the replacement work into a major rehabilitation effort.

TABLE 10-1
J.T. Myers Locks and Dam
Major Components Indicated for Replacement, by Chamber

Component	Chamber	
	Main	Auxiliary
Miter Gates	Replace	---
Lockwalls	---	---
Guardwalls	---	---
MG Monoliths	---	---
MG Sills	---	---
RT Culvert Valves	Replace	Replace
Hydraulic System	Replace	Replace
MG Machinery	Replace	Replace
CV Machinery	Replace	Replace
Electrical Systems	Replace	Replace

MG--miter gates

CV--culvert valves

Economic Evaluation. The Life Cycle Lock Model (LCLM) was used in this evaluation (see **Economics Appendix, Attachment 2, Life Cycle Lock Model** for a more detailed discussion of this model). Reliability analysis provides hazard values (probabilities of

unsatisfactory performance), and associated consequences of unsatisfactory performance. Consequences are in the form of repair costs (if any) and chamber closures (if any). These hazard values and consequences, along with a lookup table of industry delay costs by year and duration of closure, are the key inputs into the LCLM. The LCLM is a Monte Carlo type simulation model that accumulates economic costs (repair costs and industry costs) for a 50 year project life cycle in each iteration. Two repair schemes are evaluated: 1) fix-as-fail (FAF) and 2) planned replacement. Planned replacement refers to replacement of a major component in a specific year, so that LCLM runs are made for a series of replacement dates, so that the best year can be selected.

The result of successive iterations is a distribution of expected economic costs for a specific component at a specific lock chamber under either the FAF (fix-as-fail) or planned replacement. These costs can also be expressed as an expected life cycle present value cost for that component. **Table 10-2** compares expected present value costs under the two major maintenance alternatives at J.T. Myers. Only the culvert valves in the Main chamber were found to require near-term planned replacement. All remaining replacements occur in 2020 and beyond. Planned replacements have the lowest expected costs for culvert valves and hydraulic systems in the Main chamber and culvert valves, hydraulic systems, and electrical systems in the Auxiliary chamber. The lowest cost alternative for the other components was FAF.

TABLE 10-2
Summary of Component Replacement Needs at J.T. Myers
Present Value of Expected Life Cycle Costs
(thousands of \$1999, 6-7/8% discount rate, base year 2008)

	Major Component					
	Miter Gates	Culvert Valves	Hydraulic System	MG Machinery	CV Machinery	Electrical Systems
Main Chamber						
Fix-as-Fail	45.0	274.7	4,169.5	45.2	64.7	904.5
Planned Replacement in:						
2000	---	433.1	6,760.1	2,128.8	361.7	2,128.8
2010	---	249.3	4,546.1	1,549.0	196.7	1,664.2
2020	---	190.7	3,640.5	1,150.1	120.5	1,398.5
2030	854.3	172.9	2,778.8	823.9	79.7	1,209.9
Auxiliary Chamber						
Fix-as-Fail	---	435.5	95.2	1.5	2.4	99.6
Planned Replacement in:						
2000	---	333.6	282.8	408.8	231.2	408.8
2010	---	197.0	159.7	215.6	124.5	227.2
2020	---	130.7	102.6	122.4	75.7	145.4
2030	---	92.3	70.4	63.4	39.8	98.0

MG – Miter Gate
CV – Culvert Valve

The M&MR policy is a combination of the FAF and planned replacement of components. The replacement pursued is determined by what is economically justified by chamber and by component. When replacements are temporally proximate, they are bundled with the replacement of other components (like valves and culvert valve machinery). If this bundling reaches a specified dollar threshold, it is referred to as a major rehabilitation. The results of this analysis are incorporated into cost and closure matrices, which in turn are used as inputs into the system economic model. The M&MR cost and closure matrix for J.T. Myers is summarized in **Table 10-3** below, and the full matrix is displayed in Section 7 of the General Engineering (GE) Appendix. The matrix shows the schedule and costs for all major maintenance work, including major component replacement.

TABLE 10-3
Schedule of Major Maintenance Activities at Myers L&D
(millions of \$1999, 6-7/8% discount rate)

Year	Main Chamber			Auxiliary Chamber		
	Maint. Description	Days Closed	Repair Costs	Maint. Description	Days Closed	Repair Costs
2003	-	-	\$ -	Maint. Dewater	45	\$ 1,868
2004	-	-	\$ -	MG Paint	45	\$ 2,100
2006	Maint. Dewater/Appr. Wall	60	\$ 2,490	-	-	\$ -
2007	MG Repair and Paint	60	\$ 2,100	-	-	\$ -
2019	-	-	\$ -	Maint Dewater	45	\$ 1,868
2020	Hydr. System	65	\$ 2,215	-	10	\$ 200
2021	Maint Dewater	45	\$ 1,868	-	-	\$ -
2030	Culvert Valves	5	\$ 2,900	Hydr & Elec. System	60	\$ 3,642
2031	Inspection	15	\$ 525	Culvert Valve	60	\$ 1,400
2033	-	-	\$ -	Maint. Dewater	45	\$ 1,868
2034	-	-	-	Mgate Paint	45	\$ 2,100
2035	Mgate Paint	45	\$ 2,100	-	-	\$ -
2036	Maint. Dewater	45	\$ 1,868	-	-	\$ -
2051	Maint. Dewater	45	\$ 1,868	-	-	-

Notes:

1/ MG -- miter gate

2/ Maint. Dewater -- chamber is drained so that routine repairs and inspection can be performed upc features normally under water.

3/ Where components are named, a replacement has been scheduled.

Maintenance Requirements. The normal operation and maintenance (O&M) costs for continuing the existing project are estimated at \$3.15 million annually (refer to **Table 10-4**). These costs provide for staffing the project, routine operation and maintenance activities. Component replacements and cyclical maintenance cost \$1.28 million on an average annual basis, and random minor repairs are projected to cost another \$0.15 million. A \$27.5 million dam rehabilitation is scheduled for the years 2050 – 2053, with an average annual cost of \$0.10 million. Total average annual operation and maintenance costs are \$5.08 million.

Operational Alternatives

Nonstructural traffic management measures, within the current purview of the Corps of Engineers and offering opportunities for more effective use of the existing Myers project, are considered as candidate elements for inclusion in the Without-Project condition. Best-practice lockage policies and helper boats (i.e. self-help) are especially effective during high congestion situations at locks where double-cut tow operations are necessary – situations typical of a Main chamber closure at Myers. The average annual cost of this operation is estimated to be \$0.13 million. Six-up / six-down policies and helper boat operations are both employed as standard practice during Main chamber closures. As a result, both of these non-structural measures are assumed to continue into any Without-Project future condition. A form of traffic re-scheduling is also practiced during closures of the Main chamber.

As mentioned earlier, the Corps and industry work together to plan and schedule maintenance closures so as to minimize the costs for each. This pre-planning allows industry to re-schedule shipments around the closure period to the greatest practical extent. Tow arrivals are observed to diminish once delays and tows in queue reach a certain level during long duration Main chamber closures. This acts to reduce the average amount of time each tow sits in queue, reducing delay costs for the tow operators; however, chamber capacity is not increased. Discussions with shippers and towing companies indicate that while lock proximate delays and delay costs are reduced, shippers and/or producers are faced with cost increases elsewhere. Stockpiles and inventories are increased, production is re-dispatched to less efficient plants, short-term productive capacity is added or short-term alternative transportation procured. The capacity of the production and distribution system has not been increased through this re-scheduling; increased costs have merely been re-distributed throughout the system. It is assumed that shippers and carriers have made economically rational decisions in re-distributing these costs; therefore, re-scheduling as currently practiced is retained as part of the future Without-Project condition. Government-directed scheduling of tow arrivals at locks is not currently within the authority of the Corps of Engineers and was not considered as a possible component of the most likely Without-Project condition.

Navigation Benefits and Conclusion

For traffic using J.T. Myers, the transportation cost savings (benefits) over the period of analysis are estimated at \$1,558.3 million annually, far in excess of the \$5.08 million in average annual project costs for major maintenance, operations, and routine maintenance, and implementation of a helper boat program. Given this and the fact that no other nonstructural measures to improve lock efficiency were identified, the existing condition described in the preceding paragraphs is selected as the most likely Without-Project future condition at J.T. Myers Locks and Dam.

ECONOMICS OF THE WITHOUT-PROJECT CONDITION

The annual benefits, annual costs and net benefits for continuing the existing J.T. Myers project are presented in **Table 10-4**. Total average annual benefits (Myers traffic only) are estimated at \$1,558.3 million. Total average annual operations and maintenance costs are \$5.08 million. Industry delay costs incurred during unplanned component replacements are estimated at \$1.80 million on an average annual basis. These two costs total to \$6.88 million. Comparing total annual benefits and annual costs, yields net annual benefits for the Without-Project condition of \$1,551.4 million.

Traffic demands are generally accommodated over the period of analysis, except during those times when the Main chamber is closed. During closures, traffic demands and traffic accommodated can be seen to diverge in **Figure 10-1** below. Main chamber closures tend to have their greatest effect on waterway operating costs, rather than causing large diversions of demand to other transportation modes.

TABLE 10-4
Annual Benefits, Costs and Net Benefits
(millions of \$1999, 6-7/8% discount rate, base year 2008)

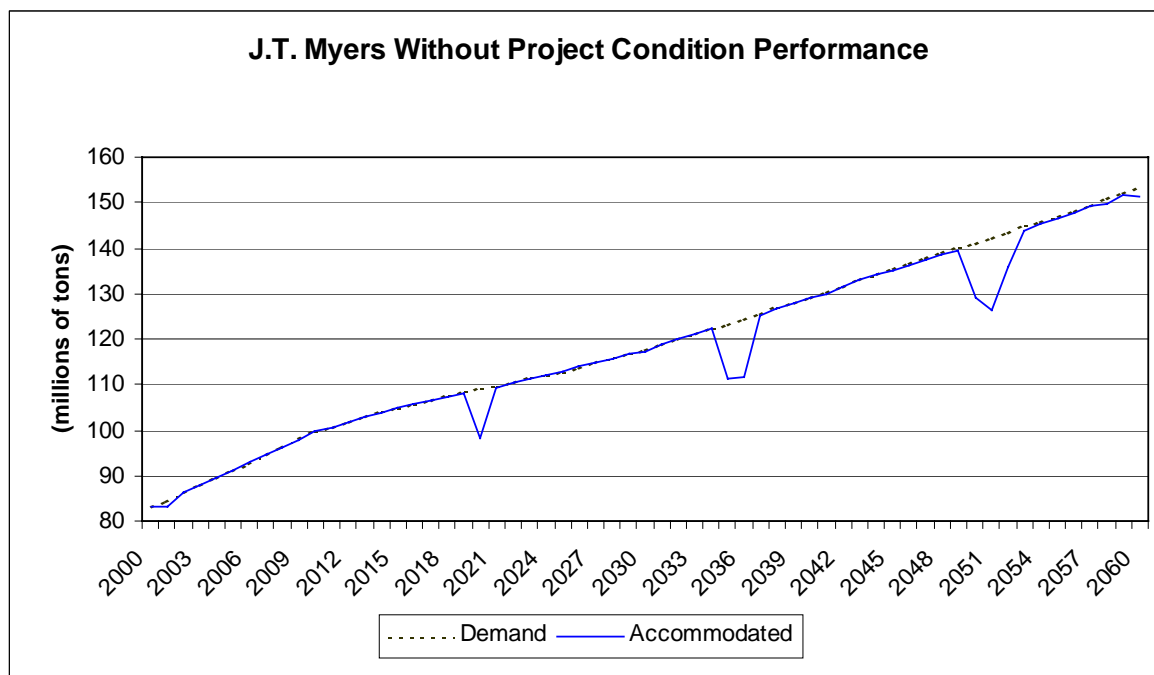
Item	Amount
Annual Benefits 1/	\$ 1,558.30
Annual Costs	
Normal O&M	\$ 3.15
Dam Rehabilitation (\$27.5 over years 2050-53)	\$ 0.10
Dredging	\$ 0.27
Main Chamber	
Component Replacement (\$4.9 over 2020 & 2030)	\$ 0.11
Cyclical Maintenance (\$16.5 in various years)	\$ 0.58
Random Minor (\$1.5 in various years)	\$ 0.13
Auxiliary Chamber	
Component Replacement (\$5.0 over 2030-31)	\$ 0.08
Cyclical Maintenance (\$13.8 in various years)	\$ 0.52
Random Minor (\$0.8 in various years)	\$ 0.02
Helper Boats	\$ 0.13
subtotal	\$ 5.08
Transportation Impacts	\$ 1.80
Total Annual Costs	\$ 6.88
Net Annual Benefits	\$ 1,551.42

1/ Only those transportation benefits realized by traffic using J.T. Myers Locks and Dam

Please note that the discount rates and work-cost estimates used in Sections 10 and 11 of this report (the Without- and With-Project screening sections) use the 6-7/8% interest rate and cost estimates available in late 1999 (at the time of the screening). However, the final With-

Project and incremental benefit-cost analyses in Section 12 use slightly updated cost estimates for the final plan (developed in January 2000) and the most recent 6-5/8% Federal discount rate. These recent minor cost and interest changes, while important in calculating the most up-to-date benefit-cost ratios, should not affect the results of the screening (plan comparison) exercises in Sections 10 and 11.

FIGURE 10-1



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SECTION 11

IDENTIFICATION of ALTERNATIVE IMPROVEMENT PLANS

This section discusses the development and screening of With-Project alternative plans for addressing the problems and needs at Myers Locks and Dam. Alternatives were formulated in a two-stage process. First, a broad range of alternatives was considered in order to identify potential measures that would make future locking conditions at Myers more efficient. Options considered which had practical application and reasonable development costs were carried forward for a more detailed evaluation based on development costs, navigation benefits, and environmental impacts. Costs and designs were developed more fully for those alternatives carried forward to the final screening. Screening at this last stage produced the final plans for detailed engineering and design and identification of the NED plan.

ALTERNATIVES CONSIDERED (INITIAL SCREENING)

In the initial review, a broad range of plans was considered. As discussed in Section 5, these alternatives were weighed against the planning objectives, namely:

- Ensure future navigability
- Improve navigation efficiency
- Conserve fish and wildlife resources

Each of several types of alternatives were considered, as discussed below.

New Locks

A totally new locks and dam project replacing Myers with twin 1200' chambers would meet navigation needs from all standpoints: 1) structural reliability, 2) ability to efficiently handle traffic during closures of the Main chamber, and 3) ability to efficiently handle future, high volumes of traffic in the later years if needed. A new project could be constructed either upstream or downstream from the present project. An upstream project would lower the pool

resulting in a shallow channel, and a downstream project would raise the pool between the old and new dams. A new project would have significant economic, environmental and social impacts.

A totally new replacement project with a 1200' Main and 600' Auxiliary would provide a more structurally reliable project, but only partially meet the needs. Any closures of the Main chamber would require all traffic to use the 600' lock. This would impose heavy delay costs on industry and congestion associated with traffic growth would still be a problem in later years.

An additional 1200' chamber (a third chamber) at the existing site results in a project with twin 1200' chambers and a backup 600' chamber (which would be used during closures of one of the 1200' chambers). This configuration has the ability to efficiently process traffic during closures of either 1200' chamber, as well as handle potentially higher volumes of traffic during the later years of the project. However, construction of a 1200' lock would impact nearly 2 miles of riverbank and result in several million cubic yards of excavation to be disposed of on vegetated land at the project.

Lock Extensions

Both a 200' and a 400' extension of the existing Auxiliary chamber were considered. These extensions would result in projects with a 1200' Main chamber and either an 800' Auxiliary or a 1000' Auxiliary, respectively. Neither alternative would efficiently process traffic during closures of the Main chamber. In 1998, 65% of the tows arriving at J.T. Myers would have to double-cut in a 1000' chamber, and 75% would have to double-cut in an 800' chamber, resulting in a continuation of serious delays and industry costs during Main chamber closures. Furthermore, these extensions are not practicable from an engineering standpoint. Culverts are located in the middle wall monoliths where the gate recesses would have to be placed. The affected middle wall monoliths would have to be taken out and rebuilt to accommodate the gate recesses. This would probably close the entire river in this vicinity for a year or more. Extending the Auxiliary chamber by anything less than 600' would have major effects on waterway traffic.

A 600' extension of the existing Auxiliary chamber results in a project with two 1200' chambers.¹ The twin 1200' configuration has the capability to efficiently process traffic during closures of either 1200' chamber, as well as handle potentially higher volumes of traffic during the later years of the project. Future major maintenance would still be required for major components at Myers to keep the project operating efficiently, including rehabilitation of the Main lock and the navigation dam.

Small Capital Improvements

Two emergency mooring cells presently are located upstream of the Myers project. While there is some industry and public interest in installation of mooring buoys or similar cells

¹ These are nominal lengths indicating the longest vessel that could safely use the facility. Pintle-to-pintle length of the extended chamber is over 1300 feet at Myers.

downstream of the project, this small-scale improvement does nothing to reduce approach times and increase efficiency of the project.

Guardwall and middle wall extensions in the upper pool of the existing project have the potential to significantly reduce interference between tows concurrently using the Main and Auxiliary. Minimizing interference has the potential to reduce lock delays when traffic reaches the level where both chambers are highly utilized. Nevertheless, wall extensions are not expected to provide the capacity expansion needed to handle future traffic volumes during the later years of the project, nor will they reduce delays when the Main chamber is closed for maintenance (when interference between chambers is not the main problem).

A Miter Gate Quick Changeout System (MGQCS) could be used to shorten closure durations for maintenance or accident requiring miter gate removal. This alternative requires a towboat equipped with a heavy-duty crane, a specially equipped barge, gates modified for lifting by a crane, an on-site set of additional gates, and an assembly/storage/staging area for these gates. The MGQCS allows maintenance closures involving the chamber gates to be significantly shortened, easing the closure-related delay costs experienced by industry.

Non-Structural Measures

Locks nearing their practical capacity limits can benefit from a traffic-scheduling program that assigns tow arrival times. The goal of such a scheduling program is to reduce delays and their associated costs. However, there are some critical limitations to scheduling. Shipments must still occur, forcing shippers to either re-route these moves to a more expensive transportation mode, re-dispatch their production to less efficient plants, or re-schedule these shipments for another time. Re-scheduling shipments is more costly as well. The shipper may have to pay higher, short-term costs for waterway service, and stockpiles will either have to be built-up or drawn-down prematurely at an additional cost to the shipper, which in turn may involve additional handling costs. In short, the capacity of the production and distribution system is not increased through a scheduling program during Main chamber closures; increased costs are merely re-distributed throughout the production and distribution system. Scheduling does not address the need for additional Auxiliary chamber capacity and is unable to alleviate the adverse economic impacts of closure.

A congestion lockage fee would be used to influence the shipper with very marginal savings for barge shipments to shift their traffic to an alternate overland mode, thereby reducing the amount of lock congestion. Thus it serves as a program for rationing lock use to those movements with the highest marginal savings. The result would be an increase in total rate savings net of delay costs for shippers that continue to use the waterway. This alternative would reduce traffic queues and therefore industry costs at the locks.

Summary of Initial Screening

The initial screening retained some alternatives and eliminated others based on navigation conditions, development impacts and other qualitative criteria. The results of the initial screening are discussed below and summarized in Table 11-1.

Non-Structural Measures

Helper boats increase the efficiency of Auxiliary lockages but do not reduce the amount of time this lock must be used. Consequently helper boats have not been evaluated as a separate alternative, but are part of the Myers WOPC. Congestion fees could influence shippers with marginal savings to leave the waterway and use other modes of transport. The result would be a reduction in lock congestion and traffic queues, and an increase in net rate savings for those shippers who continue to use the waterway. This alternative has been retained for further evaluation.

Traffic scheduling could be used to reduce delays at locks that are at or near capacity. However, the larger and more complex the production and distribution systems for the commodities being shipped, the more difficult it is to reduce overall transportation cost. Also, owners and shippers are faced with other cost increases, such as additional stock piling, shifts in production locations and use of more costly transport modes. Since formal traffic scheduling would not increase lock capacity nor significantly reduce the overall cost of waterway transportation in the mid-Ohio navigation system, it has been dropped from further consideration.

Small Capital Improvements

A miter gate quick changeout system (MGQCS) would reduce lock closure duration for any maintenance or accident requiring gate removal thereby reducing industry delay costs. Because of its obvious benefits and relative low cost, this alternative has been retained for further evaluation.

Extension of the middle lock guard wall in the upper approach at Myers (in lieu of other improvements such as actual chamber lengthening) would reduce interference when traffic reaches a level such that both the Main and Auxiliary chamber is being heavily used. Guardwall extensions, however, would not reduce delays when the Main chamber is closed for scheduled maintenance or repair. Hence, benefits are very small compared to the costs involved. Therefore, this alternative was not retained for further investigations.

TABLE 11-1. MYERS L&D: INITIAL SCREENING OF ALTERNATIVES

Alternative	Maintenance Closures	Auxiliary Capacity	Development Cost	Environmental Impacts	Social-Cultural Impacts	Future Nav. Needs	Conclusion
NON-STRUCTURAL MEASURES							
Congestion Fees	Does Not Reduce Closure Frequency/Durations	Reduces Delays by Lowering Traffic Demands – no effect on lock capacity (throughput)	Lowest Cost	Min. Impacts	No Impacts	Partially Meets Needs	Retained
Traffic Scheduling	Does Not Reduce Closure Frequency/Durations	Slightly Decreases Aux. And Overall Project Delays – no effect on capacity	Lowest Cost	Min. Impacts	No Impacts	Does Not Meet Needs	Dropped
SMALL CAPITAL IMPROVEMENTS							
Guard-Wall Extension	Does Not Reduce Closure Frequency/Durations	Slightly Increases Lock Capacity by Reducing Interference	Low Cost	Min. Impacts	No Impacts	Does Not Meet Needs	Dropped [1]
Miter Gate Quick Changeout System	Reduces Closure Durations	Slightly Increases Overall Capacity by Reducing Closure Durations	Low Cost	No Impacts	No Impacts	Partially Meet Needs	Retained

[1] Evaluated as part of the Without Project Condition

TABLE 11-1 (continued). MYERS L&D: INITIAL SCREENING OF ALTERNATIVES

Alternative	Maintenance Closures	Auxiliary Capacity	Development Cost	Environmental Impacts	Social-Cultural Impacts	Future Nav. Needs	Conclusion
NEW LOCK CHAMBERS							
Replacement Project, 1200' & 600' Locks	Reduces closure frequency and durations	Increases effective capacity by reducing closures	Excessive Cost	Major Impacts	Major Impacts	Partially Meets Needs	Dropped
Replacement Project Chamber, Twin 1200' Locks	Reduces closure frequency and durations	Maximizes capacity, with two large locks	Excessive Cost	Major Impacts	Major Impacts	Meets Needs	Dropped
Third 1200' Chamber, Existing Site	Reduces closure frequency and durations	Maximizes capacity at existing site	High Cost	Major Impacts	Minor Impacts	Meets Needs	Dropped
LOCK EXTENSION							
Extend Auxiliary Additional 200' – 400'	Does not reduce closure frequency/durations	Slightly increases Aux. capacity by eliminating some double lockages	High Cost	Minor Impacts	Minor Impacts	Does Not Meet Needs	Dropped
Extend Auxiliary, Additional 600'	Does not Reduce closure frequency/durations	Increases Aux. capacity by eliminating all double lockages	Moderate Cost	Minor Impacts	Minor Impacts	Meets Needs	Retained

New Locks

A new locks and dam project either upstream or downstream from the Myers Dam would provide excellent navigation conditions and meet all future needs. The cost of a new project at any location, however, is excessive when compared to the cost of providing similar lock capacity at the existing site. The adverse environmental and social impacts of such a major development also would be significant. Because of these reasons, the new project alternative was dropped from further consideration. Likewise, a new 1200' foot lock could be constructed at Myers, landward of the existing Auxiliary chamber. The estimated cost of \$300-\$350 million for a new 1200' lock is high when compared to the cost of other options for reducing lock delays at the project. Consequently, this alternative was not retained for further consideration.

Lock Extensions

The Auxiliary chamber at Myers could be lengthened by extending the chamber walls downstream and adding new upper and lower guide walls. The extensions could vary from 200 feet up to 600 feet, which would provide an Auxiliary lock 1200'x110'. Any extension less than 600 feet would still require double lockages when the Main chamber is closed. The extended chamber could continue to use the existing filling and emptying system (F/E), which would be somewhat slower, or construct new culverts, which would be faster but more costly. Extension of the Auxiliary lock 600 feet with the option of constructing F/E culverts now or at a later date would meet future navigation needs at much less cost than for a new lock. This alternative has been retained for further investigations.

ALTERNATIVES EVALUATED (FINAL SCREENING)

One non-structural alternative (congestion fees), one small capital investment alternative (MGQCS), and one structural alternative (a 600' extension of the existing Auxiliary lock) have been retained for evaluation following the initial screening. The criteria used for this final evaluation and screening include costs and net benefits, environmental impacts, and future navigation needs. The results of this evaluation and screening are discussed below and summarized in Table 11-2.

Congestion Fees

A series of congestion fees were evaluated at different times in the 50-year project life. Analyses indicated that no one fee was best, but rather they varied each year based on traffic, closures, etc. In a situation where daily traffic levels have nearly reached capacity, congestion fees have been successful in moving marginal movements off the waterway, at an advantage to the entire system. Congested situations are projected to occur during Main chamber closures, but

not on a daily basis. Current non-structural measures employed by industry in these situations, particularly helper boat operations and traffic re-scheduling (making shipments ahead of or after lock closures), keep delays from reaching extremely high levels where congestion fees might be more effective.

Miter Gate Quick Changeout System (MGQCS)

A miter gate quick changeout system (MGQCS) would be used to shorten closure durations for any kind of maintenance or accident requiring gate removal. Operations and Engineering personnel estimated that a closure for gate maintenance could be reduced from 45 days to 15 days at Myers once the system is fully implemented. This alternative requires a derrick boat with heavy-duty crane, gates modified for lifting by crane and an on-site set of additional gates. This alternative allows maintenance closures involving lock chamber gates to be significantly shortened, reducing the closure-related delay costs experienced by industry. The cost of providing one pair of additional gates, an onshore gate assembly pier, quoin modifications, and other incidentals for this plan is estimated to be approximately \$14.2 million dollars.

Auxiliary Lock Extension

A 600' extension of the Auxiliary chamber results in a project with twin 1200' chambers. This lock configuration would efficiently process traffic during closures of either the existing Main lock or the extended Auxiliary lock. It is capable of handling a higher volume of traffic that could develop during later years of the project. Four different design variations of this alternative have been evaluated in detail. The design variations relate to different options regarding the filling and emptying system for the extended lock. Pertinent aspects of the plans are summarized below and design details and cost estimates are provided in the Engineering Appendix.

- Plan 1. The Auxiliary chamber would be lengthened to 1200' by extending the chamber walls and the upstream and downstream guide and guard walls. The longer guide walls provide sufficient landing for 1200-foot tows. The extended chamber walls would accommodate construction of a new downstream miter gate bay. The existing filling and emptying (F/E) system would be used for the extended chamber resulting in longer filling and emptying times. If any improvements to the F/E system would be required in the future, then major modifications including lengthy closure of the extended Auxiliary chamber would be necessary.
- Plan 2. This plan would include all the features of Plan 1 plus the following:
 - - A culvert in the extended lower land wall.
 - - Outlet culvert and emptying valve which would allow for faster emptying of the extended chamber.

- - New laterals in the extended chamber bottom to permit faster emptying time for the lock. This plan would have dual emptying systems, and a new filling system could be added in the future, if economically feasible, with minimum impacts to lock traffic.
- Plan 3. This plan has all the features of Plan 2 with the addition of a supplemental filling system. A new “wrap-around” culvert would be constructed from a new intake structure to the extended chamber land wall. This plan includes a fully functional F/E system resulting in F/E times comparable to other Ohio River locks and results in a full service lock.
- Plan 4. This plan has all the features of Plan 3 except that the new filling and emptying system would be constructed in two phases. The first phase would be essentially Plan 2, the basic lock extension with certain modifications that would permit the addition of a new filling culvert at some future date. The second (future) phase would involve construction of the intake structure and wrap-around filling culvert. After completion of this phase the plan would be nearly identical to Plan 3. Future construction would not be undertaken until traffic needs would justify a more efficient filling system.

Plan 1 would not have fully functional filling or emptying systems. Therefore, the time required to fill and empty the longer chamber is unknown at this time, but preliminary testing indicates that it would at least double the time required to fill and empty the existing 1200' chamber. Plan 2 has a fully functional emptying system, but not filling system. Therefore, Plan 2 would empty as fast as a standard lock, but filling would take considerably longer as discussed for Plan 1. How efficient the use of the original filling and emptying (F/E) system would be for the extended chamber cannot be fully determined until the next study phase (PED) and requires the use of physical models at WES. If the existing F/E system can be used, the development cost for the lock extension will be less than if a totally modified F/E system is necessary. Since all the detailed design data necessary to optimize the F/E system is not available for this feasibility analysis, Plan 3 has been used for the purposes of formulating final alternatives, as a plan that typically represents the desired lock extension alternative. Even without the benefit of physical model results, there is confidence that the modified F/E system included in Plan 3 will perform satisfactorily for the extended lock.

TABLE 11-2. MYERS L&D: FINAL SCREENING OF ALTERNATIVES

Alternative	First Cost	Total First Cost [1]	Incremental Annual Cost	Incremental Annual Benefits	Incremental Net Benefits	Environmental Impacts	Future Navigation	Conclusion
Without-Project Condition	0	37.5	N/A	N/A	N/A	N/A	N/A	N/A
600' Aux. Extension with Culverts	166.0	203.6	10.0	18.8	8.8	Minor Aquatic & Riparian	Meets Needs	Highest Net Benefits – Retained
Miter Gate Quick Changeout System (MGQCS)	14.2	51.6	0.6	2.1	1.5	No Impacts	Partially Meets Needs	Low Net Benefits – Dropped [2]
Congestion Fees	1.0	38.5	1.0	6.0	5.0	No Impacts	Partially Meets Needs	Low Net Benefits – Dropped

[1] Includes \$27.5 million dam rehabilitation in 2050-53; \$4.9million Main chamber component replacements over 2020 and 2030 and \$5.0 million Auxiliary component replacements, (millions of 1999 dollars).

[2] Dropped as separate alternative, but evaluated later as part of lock extension alternative (see Table 11-3).

SUMMARY OF ALTERNATIVES EVALUATED

Congestion fees only partially address the planning objective of efficiently passing traffic at Myers during lock closures. While congestion fees do help in reducing delays during closures of the Main chamber, industry costs (delay costs plus the fee) remain high for tows still using the lock, and marginal movements pushed off the system must pay the higher overland rate. Even though the plan has positive net benefits it is not considered a viable alternative because of the problems of implementing a congestion fee program and its inability to fully address the most pressing needs at Myers.

A miter gate quick changeout system (MGQCS) would allow maintenance closures involving lock gates to be significantly shortened, thereby reducing delay cost experienced by industry. This plan partially meets study objectives by reducing the duration of lock closures involving gate replacement, but does not fully address total delays related to lock closures. Therefore, it is not considered to be a viable stand-alone alternative, even though it has positive net system benefits. However, since this option does provide significant efficiency gains it has been included as a component in the 600' lock extension plan.

A 600' extension of the Auxiliary lock at Myers results in a project with two 1200' foot locks. This alternative meets the identified navigation needs and satisfies the planning objectives. It is the most viable alternative that is implementable. The estimated costs of the lock extensions options vary from \$142 million to \$175 million, depending on the extent of modifications to the existing filling and emptying (F/E) system. Reliance partially or totally on the use of the existing F/E system for the extended lock will result in much longer F/E time. Inefficiencies that will result cannot be fully clarified until PED studies are complete. Consequently, for the purposes of selecting the final alternatives in the feasibility study, the 600' lock extension identified in the Engineering Appendix as Plan 3, has been used to best represent the cost and operational performance of the desired lock extension alternative. Plan 3 includes a fully functional F/E system and has an estimate cost of \$174.7 million, which includes the MGQCS (See Table 11-3). Since the lock extension plan is the only viable option, with the greatest net benefits among the final alternatives, it is the NED plan, and has been designated the tentative selected plan.

TABLE 11-3. Myers Locks and Dam
Annual Costs and Benefits for Final Alternatives
(millions of October 1999 dollars, 6 7/8% discount rate, base year 2008)

Alternative	First Cost	Incremental Average Annual			BCR
		Costs	Benefits	Net Benefit	
Congestion Fee	1.0	1.0	6.0	5.0	6.0
Gate Change-out System	14.2	0.6	2.1	1.5	3.5
600' Lock Extension 1/	174.7	10.2	19.0	8.8	1.9

1/ Including the MGQCS

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EVALUATION OF FINAL PLAN (J.T. MYERS L&D)

This section provides a detailed evaluation of the final alternative plan in relation to the Without-Project condition. The evaluation process has focused on the effects of traffic delays associated with maintenance closures of the Main lock, the impacts of extension of the Auxiliary at the project site, and the analysis of benefits and costs for the final plan. The performance of the final plan is examined in terms of projected traffic, system traffic effects, and total system rates-savings. It was assumed that the year 2008 would be the earliest probable date by which any lock extension plan could be completed and operational. However, for purposes of economic analysis and impact assessment, the analysis period extends from 2000 to 2058, in order to capture construction impacts (2000-2008) and variations in lock closure schedules between the Without- and With-Project alternatives. See Figure 12-1 for a sketch showing the layout of the selected plan.

ECONOMIC IMPACTS

All economic values are expressed in October 1999 dollars. Previous sections detailing the economic screening of alternatives used October 1999 dollars and a discount rate of 6 7/8%. After the screening, the discount rate was lowered to 6 5/8%, and various late revisions were made to the cost estimates for the final (selected) plan. The current rate (6 5/8%) and revised cost data are used in the economic analysis of the final plan presented in this section, and in the sensitivity analyses presented in Section A-12 of the Economics Appendix.

Traffic

The volume of traffic that could move through J.T. Myers over the analysis period with the final lock extension plan and the WOPC is presented in Table 12-1.

TABLE 12-1. J.T. Myers Locks and Dam: Traffic Accommodated by Final Plan
(millions of tons)

Year	Demand Tonnage	Accommodated Tonnage 1/	
		Without Project Condition	600' Extension Plan
2000	83.0	83.0	83.0
2010	99.6	99.6	99.6
2020	109.1	98.4	109.0
2030	117.7	117.4	117.4
2040	129.2	129.1	129.1
2050	141.0	128.9	128.9
2060	153.4	151.1	151.3

1/ Fluctuations in accommodated traffic levels (e.g. 2050) caused by closure at Newburgh.

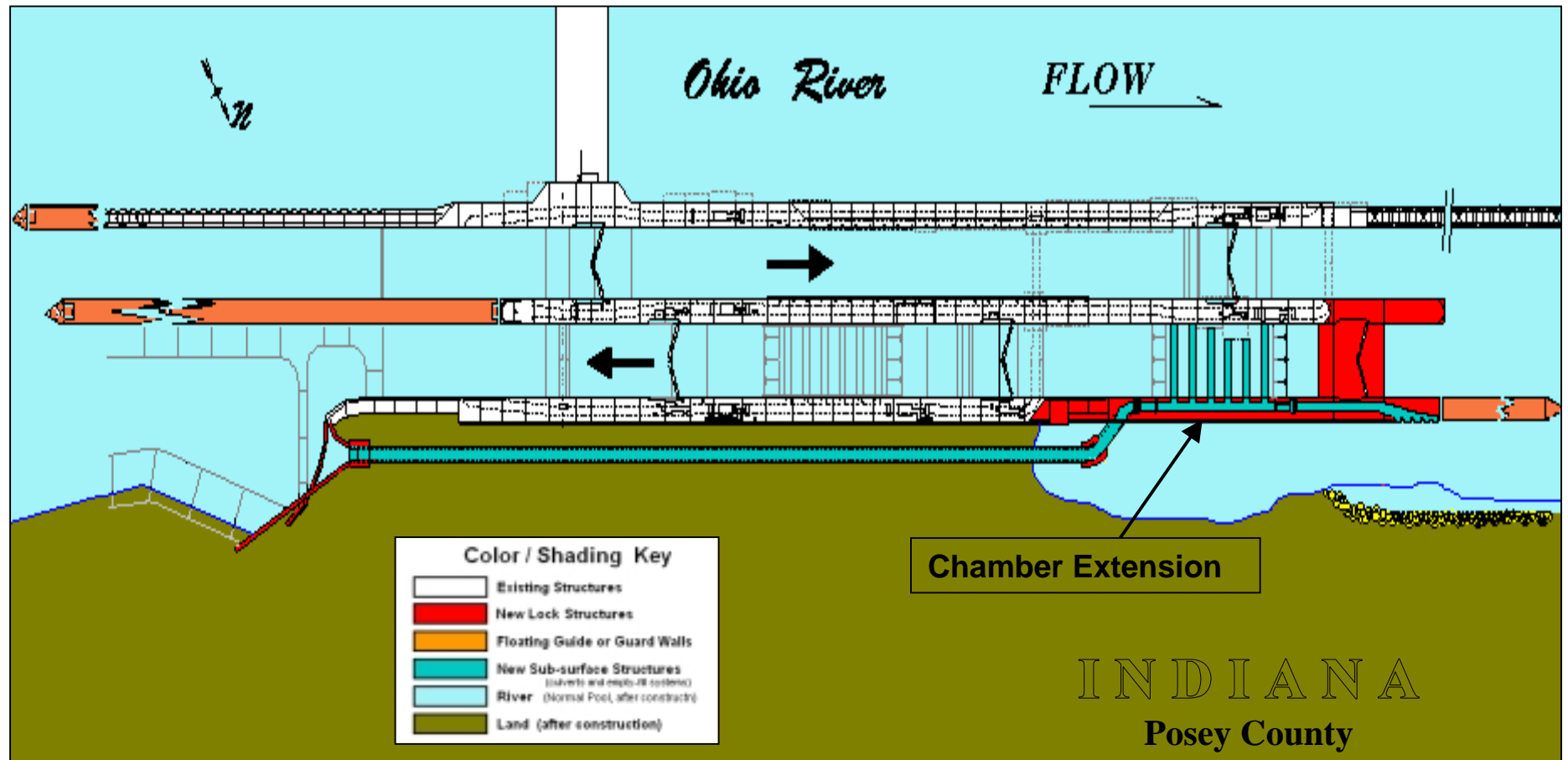


Figure 12-1. Selected (N.E.D.) Plan. Extend J.T. Myers Auxiliary chamber to 1200' length

System Impacts

Since project traffic capacity is not a significant problem at J.T. Myers L&D, and since the present locks can accommodate most of the projected traffic through 2060, there is expected to be very little if any impact on Ohio River system traffic due to the improvements being considered. Using the most-likely traffic projections, there would be very little more traffic moving on the waterways system in 2060. Only with the high growth scenario would there be significant traffic increases resulting from an extension of the J.T. Myers Auxiliary lock, including an increase in incremental system benefits. The system traffic accommodated by the final plan is displayed in Table 12-2.

TABLE 12-2.
Ohio River System Traffic Accommodated by Final Plan
(million of tons)

Year	Demand Tonnage	Accommodated Tonnage ^{1/}	
		Without Project Condition	600' Extension Plan
2000	275.7	275.6	275.6
2010	324.4	324.2	324.2
2020	354.4	343.2	353.8
2030	385.1	381.7	381.7
2040	422.7	419.2	419.2
2050	459.5	442.5	442.5
2060	493.2	465.1	465.1

^{1/} Closures assumed.

ENVIRONMENTAL IMPACTS

The following sub-sections provide a description of environmental impacts for each of the final plans. A comparative summary of this information is provided in Table 12-6 at the end of this section.

Aquatic / Riparian

There are no known habitats of special concern that would be subjected to site specific impacts. However, the lock extension plans would have direct impact at the project construction site on environmental resources including aquatic habitat, river-bed, and riparian vegetation. Impacts would be associated with dredging of the lower approach to accommodate construction of the graving yard (work site for pre-cast concrete members) and to provide sufficient depth to float in prefabricated sections, as well as with operation of a new chamber discharge system to

the land side of the landward lock wall. Long term impact of up to 10 acres of limited quality aquatic habitat would result.

Riverbed excavation to extend the lockwalls would result in the removal or disturbance of substrate habitat along with an increase in turbidity levels. Blasting necessary to remove sections of concrete lock walls would result in fish kills and the suspension of concrete fines and other riverbed material. Suspended material could drift downstream far enough to impact spawning areas and suspected mussel beds.

With respect to wetland/riparian areas, shaving of the bank in the lower approach as well as certain dredge material disposal options would produce impacts. Bank shaving would eliminate about 5 acres of bottomland hardwoods. Disposal on state- or Corps-owned lands above Hovey Lake, utilizing traditional disposal methods, would eliminate up to 200 acres of farmed wetlands.

The most probable traffic forecasts indicate there would be little difference between traffic under either the Without- or With-Project conditions.

Terrestrial

Impacts could be associated with construction staging areas, dredged-material disposal, relocation of the Corps work-boat harbor, and the previously mentioned lower approach stream bank shaving. Up to 200 acres could be impacted, potentially encompassing prairie, bottomland hardwoods, and agricultural lands (depending on the disposal plan).

With respect to floodplains, the project is located within the 100-year flood elevation. No significant impact, though, is anticipated.

Significant opportunities exist for improving environmental values in the prairie that was restored on Corps land adjacent to the locks and dam, restoration of the upstream unnamed tributary on Corps land, and restoration on mitigation lands off-site (either private, state-owned, or Corps owned lands). All potential impacts from extending the 600' lock can be mitigated through avoidance (disposal area site selection), minimization (best management practices) and replacement (mitigation for unavoidable aquatic and terrestrial impacts).

. During Preconstruction Engineering Design (PED), the Corps of Engineers will prepare a Detailed Project Report and prepare associated analyses and documentation under the National Environmental Policy Act to further evaluate disposal options at John T. Myers Locks and Dam. This process will result in final selection and design of disposal area(s).

Recreation

Some recreation facilities involving primarily fishing access would be impacted and their use disrupted during construction.

Endangered Species

Known endangered species in the area would not be significantly impacted by project construction.

Social Impacts

All real estate impacted by potential project construction are Federal project lands at J.T.Myers Locks and Dam. There are no private residences or any other structures which would be acquired or in any way impacted by the lock extension plans for J.T.Myers. However, off-site soil disposal options (the need for which will be decided during final design layouts), may require real estate easements or purchases.

Cultural Resources

The National Register of Historic Places has been consulted. There are no archaeological or historic properties located in the areas of proposed impact that are listed on the National Register. A records search at the State Historic Preservation Office (SHPO), seated in the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology, revealed that there is one prehistoric archaeological site, 12Po802, located within the primary area proposed for soil disposal. The records of the SHPO also indicate that the majority of the area had not been professionally surveyed for cultural resources. A portion of the area that is now proposed for soil disposal was subjected to an archaeological survey in 1995. This was accomplished by the Louisville District in response to the proposed construction of a workboat mooring facility. The site was examined by means of shovel probing and backhoe trenching. The construction site was shown to have been considerably disturbed during the construction of the existing locks and dam. The area had, furthermore, been covered with up to ten feet of new alluvium. No archaeological resources were discovered to exist in this area. The SHPO concurred with the findings of this report.

Two additional investigations were initiated in order to comply with Section 106 of the NHPA relevant to the remaining, unsurveyed portions of the project area. The first of these is a geomorphological assessment and preliminary Phase I level archaeological investigation that was done through contract to Gray & Pape, Inc. of Cincinnati in 1999. The design of this investigation was to determine, by means of coring and backhoe trenches, the extent of the disturbance incurred as a result of the construction of the existing locks and dams, the nature of the geomorphological deposits present, and the potential for deeply buried archaeological resources. The report found that the entire area examined had been significantly disturbed by the earlier construction. As with the previous survey, recently deposited silt overburden covered the disturbance. No evidence of cultural resources was found to exist within the project area. It was concluded that the potential for cultural resources within the project area is minimal to non-existent. The report of findings of this investigation was forwarded to the SHPO for comments. A letter of concurrence is expected at any time.

The Louisville District conducted a second Phase I-level investigation during the summer of 1999 that expanded on the area examined during the geomorphological study. A total of twenty-seven deep backhoe trenches were excavated. Findings similar to those of the previous two studies were obtained. No cultural resources were identified. In addition, the area of site 12Po802 was examined. No evidence of this site was found. The site had been reported by an amateur in the 1980s, and had never been examined by a professional archaeologist prior to its recordation. There was therefore minimal information regarding the site aside from the claim that it dates to the Mississippian prehistoric period. The purported site location was examined by means of shovel probing and deep backhoe trenches. The area was found to be considerably disturbed by construction related to the original construction of the locks and dams. Therefore, it is not likely that a site could have been found there during the 1980s. It is most probable that the site was mis-mapped. The report of findings of this investigation is presently being coordinated with the SHPO.

Based on the findings of three investigations, the proposed action will have no effect on any cultural resources that are listed on, or eligible for listing on, the National Register of Historic Places. No further archaeological investigation is recommended for the project area as it is currently defined. If the area of proposed impact is expanded, additional coordination with regards to cultural resources will become necessary. Specifically, two alternative soil disposal areas have been identified. These areas have not been included in any of the archaeological investigations to date. A records check has been done for these areas. There are several known archaeological sites contained within the proposed alternative disposal sites. If the use of these areas is determined to be necessary, additional Phase I archaeological survey will be required and must be coordinated with the SHPO.

Ohio River System Environmental Impacts

There is potential for system-wide traffic impacts associated with navigation improvements. Such impacts occur whenever Federal actions provide for increased navigation traffic throughout the river system. However, for J.T.Myers L&D, economic projections indicate there will be continued traffic growth both with and without the recommended improvements. The potential for system-wide environmental impacts, therefore, is not anticipated because future traffic levels are expected to be essentially unchanged.

The potential exists for some synergy between the recommended improvements at Myers and potential improvements at other system navigation projects that could result in increased traffic at Myers. For example, approximately one-third of the movements transiting the upper Ohio River projects (Emsworth, Dashields, and Montgomery) also moves through Myers. This could suggest that future traffic at these projects would be influenced by improvements at Myers. However, since Myers now has the capacity to handle all forecasted traffic, no synergistic traffic increase would be anticipated for the system at large because of recommended improvements at Myers. Also, future traffic demands associated with potential improvements at upper river projects are not expected to be impacted by any improvements at Myers since traffic common to all these projects would remain relatively constant with or without any changes at Myers. In summary, current traffic analyses indicate that improvements at Myers would not contribute to increased river traffic that may result from potential improvements at any other project within the

system, and cumulative navigation traffic impacts to the Ohio River ecosystem, therefore, are not expected.

Environmental Mitigation

The Louisville District has examined the possible effects related to navigation traffic associated with the Without-Project condition and an extension to the 600-foot Auxiliary lock chamber at J.T. Myers Locks and Dam. The tools used in this assessment were the Navigation Predictive Analysis (NAVPAT) model and the Queuing Predictive Analysis (QUEPAT) model. These models are habitat-based models that use indicator species models to reflect changes in habitat conditions that may be attributed specifically to commercial navigation traffic at planning stages of a project. Furthermore, these models reflect specific life-stages of indicator species to better assess at which point in an indicator species life commercial navigation traffic may be a factor. The modeling has forecasted impacts to several species life-stages for which mitigation measures can be developed. Additionally, several species' life-stages may be adversely impacted but specific mitigation measures cannot be developed. The species in this latter category may, however, benefit indirectly by the proposed mitigation measures and any positive considerations will be noted where appropriate in the following analysis.

The search for possible aquatic mitigation sites in the Myers project area included both Myers and Smithland navigation pools. These two pools were identified as the best locations for mitigation measures as the projected effects from commercial navigation traffic due to Myers 600-foot lock extension are limited to these pools. The range of possible sites where mitigation measures may be practicable or their success likely feasible are limited as basic aquatic habitat parameters must be present (depth, velocity, substrate) or no amount of “measures” can provide habitat improvements. Project sites were found in these two pools that did possess the basic habitat parameters that could then be “improved” to result in greater habitat value.

Proposed Mitigation Measures

Seven aquatic habitat projects have been proposed to offset losses in habitat values due to the extension of the Myers Auxiliary lock. As shown in Table 12-6, the total first-cost of these projects are estimated at \$4.6 million. The projects include:

Project Site 1: The objective of this project is to replace shallow water habitat for juvenile sauger and other fishes that share similar habitat requirements. Mitigation will be to build simple rock structures in of J.T. Myers Dam back channel and provide small additional flow by cutting a notch in the Myers Dam fixed weir.

Project Site 2: The objective of this project is to replace shallow water habitat for juvenile fish species lost from shallow water river habitat by navigation tow impacts. Mitigation will be to reopen Sisters Island back channels by breaching existing rock dikes that were constructed in early 1900's for navigation purposes and are no longer needed for that function.

Project Site 3: The objective of this project is to replace shallow water habitat for juvenile fish species lost from shallow water river habitat by navigation tow impacts. Mitigation will be to provide permanent shallow water habitat in back channel of Slim Island Towhead (ORM 837) by protecting head of eroding island

Project Site 4: The objective of this project is to replace shallow water habitat for juvenile fish species lost from shallow water river habitat by navigation tow impacts. Mitigation will be to provide permanent shallow water habitat in back channel of Slim Island and Towhead Island (ORM 832.5) by protecting heads of two eroding islands.

Project Site 5: The objective of this project is to replace shallow water habitat for juvenile fish species lost from shallow water river habitat by navigation tow impacts. Mitigation will be to provide permanent shallow water habitat in back channel of Stewarts Island (ORM 912.5) by protecting the shoreline of the eroding island.

Project Site 6: The objective of this project is to replace shallow water habitat for juvenile fish species lost from shallow water river habitat by navigation tow impacts. Mitigation will be to provide permanent shallow water habitat in back channel of Deadmans Island (ORM 808.5) by protecting head of eroding island and extending protection down back channel side of island.

Project Site 7: The objective of this project is to replace hard substrate habitat for juvenile sauger and paddlefish lost in excavation of lower approach at Myers. Mitigation will be to provide permanent submerged rock dikes below tainter gates of J.T. Myers Dam.

Project Site 8: The loss of up to 2100 ft. of natural bank aquatic habitat would be mitigated by use of bioengineered features that would replace value of the lost habitat. Where riprap is required, mitigation measures could include irregularly placing rubble to create velocity shelters, burying horizontal pipes (2-ft plus diameter, closed at back end) as nesting habitat for catfish and other species, and restoring riparian forest to help stabilize the bank.)

Project Site 9: Restore the water control structure at Little Pitcher Lake if damage occurs during bank reshaping.

Project Site 10: The loss of approximately 5 acres due to bank shaping would be mitigated by riparian forest. Details can be found in Appendix G to the EIS.

Project Site 11: The preferred disposal site (site "1A") would be revegetated with appropriate riparian species, possibly bottomland hardwoods. Organic material would be added to the surface layer of the restored site to ensure quality of the topsoil. . During Preconstruction Engineering Design (PED), the Corps of Engineers will prepare a Detailed Project Report and prepare associated analyses and documentation under the National Environmental Policy Act to further evaluate disposal options at John T. Myers Locks and Dam. This process will result in final selection and design of disposal area(s).

ECONOMIC ANALYSIS

The costs and benefits for the final lock extension plan at J.T. Myers are summarized in this section. The costs and benefits for the plan represent the incremental differences between the With condition (new construction) and the Without condition. The analyses have been completed using a 50-year period of analysis (project economic life). The base year for economic analysis is 2008, the earliest completion date for a lock extension project. Benefits and costs are both expressed in October 1999 prices.

First Cost

Costs for the final lock extension plans are summarized in Table 12-4. A more detailed baseline cost estimate (to the sub-feature account level) is included in the Engineering Appendix (Document ED-1). The plan costs include extension of the Auxiliary lock to 1200 feet, with a supplementary filling culvert, and rehabilitation of the locks and the navigation dam (work items which are also part of the Without-Project condition).

TABLE 12-4.
J.T. Myers Locks and Dam -- Summary of First Costs for Final Plans
(Millions of 1999 Dollars)

Item	First Cost
Near Term Project Costs	
New Lock Construction	
Lands and Damages	-
Relocations	-
Locks	128.9
Fish & Wildlife	4.6
Buildings, Grounds, & Utilities	9.8
Planning, Engineering & Design	19.8
Construction Management	9.9
Subtotal New Lock Construction	173.0
Miter Gate Quick Changeout	8.7
Subtotal Near Term Project Costs	181.7
Longer Term Project Costs	
Component Replacements	10.0
Dam Rehabilitation	27.5
Subtotal Long Term Costs	37.5
TOTAL LIFE CYCLE PROJECT COSTS	219.2

1/ Project costs shown in this table are all first costs expressed in October 1999 dollars, regardless of when the expenditure occurs. Numbers may not add due to rounding.

Investment Cost

Investment costs are the sum of construction expenditures and the accrued interest (interest during construction or IDC) on those expenditures up to the time the new lock extension is operational and the project begins producing benefits. Investment costs also include any major maintenance expenditures made during the economic life of the project. Such expenditures include component replacements, rehabilitations and installation of the MGQCO system under the With Project plan. For these post online costs, the opposite of IDC is applied and the costs are discounted to the online date before amortizing. The earliest time that a lock extension project is estimated to be operational is 2008, thus 2008 serves as the base year for amortization. Investment costs for the final plan are displayed in **Table 12-5** below.

Annual Costs

The total annual costs for the final plans are the summation of the annualized capital costs and the estimated O&M cost. Annualized capital costs include interest and amortization charges on the investment cost and were computed using an interest rate of 6-7/8% and economic life of 50 years. The normal O&M costs are based on actual day to day operating expenses at J.T. Myers as well as other locks and dam projects on the Ohio River. The O&M costs include cyclical maintenance, which are costs for repair and equipment replacement for the locks, but are not of the magnitude to be classified as major rehabilitation or major component replacement. Dredging costs for the lock approaches are the same for With and Without conditions. A summary of annual costs is included in **Table 12-5** below.

TABLE 12-5. J.T. Myers Locks & Dam
Summary of Investment and Average Annual Costs for the Final Plan
(millions of October 1999 dollars, 6 5/8% discount rate, base year 2008)

Item	Without Project Condition	Final Plan (600' Extension)
INVESTMENT COSTS		
New Construction	-	173.0
Dam Rehabilitation	27.5	27.5
Component Replacement	10.0	10.0
Miter Gate Quick Changeout (2008-2016)	-	8.7
subtotal	37.5	219.2
IDC (new construction)	-	5.7
Discounting of post 2008 work	(33.2)	(37.8)
Total Investment Costs 1/	4.3	187.2
AVERAGE ANNUAL COSTS		
Capital Costs	0.3	12.9
O&M Cost		
Normal O&M	3.1	3.1
Helper boats	0.1	0.0
Cyclical Maintenance	1.2	0.9
Dredging	0.3	0.3
Transportation Cost Impacts	1.8	-
TOTAL AVERAGE ANNUAL COSTS 2/	6.8	17.1
INCREMENTAL AVERAGE ANNUAL COSTS	--NA--	10.3

1/ Total investment costs include the project costs (see Table A-11-3) plus interest during construction charges.

2/ Total annual costs are the average annual discounted values of total investment costs (capital costs), O&M costs, and transportation impacts incurred throughout the life of the project.

Annual Benefits

Incremental average annual benefits attributable to the final plan come from two sources: 1) transportation savings and, 2) construction employment impacts. The navigational benefits for the final plan represent the increase in total system transportation cost savings over the Without Project condition. Labor drawn from counties with substantial and persistent unemployment relative to the U.S. as a whole is accountable as a project benefit and is included in NED benefits estimates for the recommended plan. These construction employment impacts at J.T. Myers amount to \$0.05 million on an average annual basis. A summary of the incremental annual benefits, incremental annual costs, net annual benefits, and benefit-cost ratios are presented in Table 12-6. A comprehensive analysis and comparison of the navigational, economic, and environmental aspects for the final plans are provided in Table 12-7.

TABLE 12-6.
J.T. Myers Locks and Dam
Summary of Annual Benefits and Costs for Final Plan
(millions of October 1999 Dollars, 6 5/8% Discount Rate, base year 2008)

Item	600' Extension
Incremental Annual Benefits	\$ 18.9
Incremental Annual Costs	\$ 10.3
Net Annual Benefits	\$ 8.6
Benefit Cost Ratio	1.8

Benefits includes \$0.05 million (average annual) benefits for construction activities associated with the lock extension plan. (Refer to the Economics Appendix, Document EC, Attachment 6 for details).

Sensitivity analyses were performed to test the above results against different traffic scenarios and various timing options. Details on these sensitivity analyses are presented in the Economics Appendix (Document EC). These analyses confirmed the value of completing improvements at J.T. Myers L&D by year 2008, with the benefits shown in the Table above.

TABLE 12-7.

**Ohio River Mainstem System / J.T. Myers L&D
Summary Analysis of Final Plan (Sheet 1 of 4)**

Item	Without-Project Condition	Auxiliary Lock Extension
1. Plan Description	No chamber Major Rehabs required. Rehabilitate dam by 2053.	Lengthen Auxiliary lock to 1200' including new culverts for filling and emptying system by 2008. Includes Major Rehab of dam by 2053. Install quick gate changeout system (MGQCS).
2. Navigability	Main lock (110' x 1200') and Aux. lock (110' x 600) provide adequate capacity. However, Auxiliary lock alone (as during Main closures) is not adequate.	Aux. chamber is improved and lengthened. Auxiliary lock provides adequate capacity when Main Lock is closed.
3. Performance Indicators		
<i>a. Lock Capacity</i>	174 Million tons annually	243 Million tons annually
<i>b. Lockage Policy</i>	Use of helper boats when Main chamber is closed.	Single lockages for 1200' tows in both Main and Auxiliary locks. No helper boats required during closures.
<i>c. Accommodated Traffic</i>	Reaches 100 mil tons by 2010 and grows to 151 million by 2060. All traffic is served when the Main lock is operational.	Reaches 100 million tons by 2010 and grows to 151 million by 2060. All traffic demands met.
<i>d. Average Delays</i>	Maximum annual delay of 36 hrs/tow during analysis period	Maximum annual delay of 4 hrs/tow during analysis period.
4. Real Estate and Relocations	None required.	Use Federal land at site for soil disposal. No structures or relocations required. During Preconstruction Engineering Design (PED), the Corps will prepare a Detailed Project Report and prepare associated analyses and documentation under NEPA to further evaluate disposal options at John T. Myers L&D. This process will result in final selection and design of disposal area(s).

TABLE 12-7. (continued)
Ohio River Mainstem System / J.T. Myers L&D
Summary Analysis of Final Plan (Sheet 2 of 4)

Item	Without-Project Condition	Auxiliary Lock Extension
5. Economic Analysis <i>(millions of 1999\$ @ 6 5/8%)</i>		
<i>a. Life Cycle Investment Cost</i>		
-New Construction (2006-07)	0.0	173.0
-MGQCS	0.0	8.7
	<hr/>	<hr/>
-Subtotal, Authorization Work	0.0	181.7
-Dam Rehab (2050-53)	27.5	27.5
Component Replacement (various years)	10.0	10.0
	<hr/>	<hr/>
-Subtotal, Long-Term Cost	37.5	37.5
	<hr/>	<hr/>
-Total Life-Cycle Project Cost	\$ 37.5	\$ 219.2
IDC (new construction)	0	5.7
Discounting of post 2008 work	- 33.2	- 37.8
	<hr/>	<hr/>
-Total Investment Cost	\$ 4.3	\$ 187.2
<i>b. Annual Cost</i>		
-Capital Cost	0.3	12.9
-Normal O&M Cost	3.1	3.1
-Helper Boat Costs	0.1	--
-Cyclical Maintenance & Dredging	1.5	1.2
-Transportation Cost Impacts	1.8	--
-Total Annual Costs	\$6.8	\$17.1
<i>c. Incremental Annual Cost</i>	N/A	\$10.3
<i>d. Incremental Annual Benefits</i>	N/A	\$18.9
<i>e. Net Annual Benefits</i>	N/A	\$8.6
<i>f. Benefit-Cost Ratio</i>	N/A	1.8

TABLE 12-7. (continued)
Ohio River Mainstem System / J.T. Myers L&D
Summary Analysis of Final Plan (Sheet 3 of 4)

Item	Without-Project Condition	Auxiliary Lock Extension
6. Environmental Impacts <i>a. Wetland / Riparian</i> <i>b. Aquatic Habitat</i> <i>c. Terrestrial Habitat</i> <i>d. Floodplains.... (below 100 yr flood)</i> <i>e. Endangered Species</i>	<p>Conditions are good; no change anticipated.</p> <p>Conditions are good. Slight negative impact from longer queues.</p> <p>No impacts.</p> <p>No impacts.</p> <p>Indiana bat, bald eagle, fat pocketbook mussel</p>	<p>Up to 5 acres of riparian habitat destroyed. Impacts fully mitigated.</p> <p>Negative impacts from lock wall demolition & excavation of river bed resulting in fish kills & loss of aquatic habitat. Impacts fully mitigated.</p> <p>Construction-staging area and disposal of fine material on 50 to 100 acres of prairie. Mitigation measures would offset losses.</p> <p>During Preconstruction Engineering Design (PED), the Corps will prepare a Detailed Project Report and prepare associated analyses and documentation under NEPA to further evaluate disposal options at John T. Myers L&D. This process will result in final selection and design of disposal area(s).</p> <p>Disposal on fields will not impact 100-year flood level.</p> <p>No significant impact</p>
7. Cultural Resource Impacts	<p>None. No cultural resources sites exist within the project area.</p>	<p>None. Archaeological survey has been conducted. No cultural resources sites have been identified. No additional archaeological investigation is required. Coordination with the SHPO is on-going.</p>
8. Social Impacts	<p>No Impacts.</p>	<p>No Impacts.</p>

TABLE 12-7. (continued)

**Ohio River Mainstem System / J.T. Myers L&D
Summary Analysis of Final Plan (Sheet 4 of 4)**

Item	Without-Project Condition	Auxiliary Lock Extension
9. Plan Evaluation		
<i>a. Planning Objectives</i>		
- Ensure Future Navigability	Partially met. Delays significantly increase during Main lock closures.	Fully met.
- Improve Nav. Efficiently	Not met. Delays increase as Main lock closures become more frequent.	Fully met. No double lockages.
- Conserve FWL Resources	Longer queues in out-years could adversely impact mussel beds.	All onsite impacts fully mitigated.
<i>b. Addresses Industry Needs</i>	Not met.	Met.
<i>c. Shippers / Marine Industry Preference</i>	Second Choice	First Choice
<i>d. Evaluation Criteria</i>		
- Completeness	Yes	Yes
- Effectiveness	Least	Most
- Efficiency	Second	First
- Acceptability	Least	Most

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Formulation

Part B

Plan Formulation data specific to the Greenup Lock & Dam Site

Section 13:
Greenup Without-Project Condition

Section 14:
**Identification of Alternative
Improvement Plans**

Section 15:
Evaluation of Final Plan

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SECTION 13

GREENUP WITHOUT-PROJECT CONDITION

Section 7 established the need and priority for improvements at Greenup (as well as J.T.Myers L&D) on the basis of system-wide Without-Project evaluation. This section provides specifics on:

- problems and needs at Greenup (the existing condition);
- determination of the most-likely future Without-Project Condition for the Greenup site.

EXISTING PROJECT AND THE WITHOUT-PROJECT CONDITION

Project Description

Greenup Locks and Dam has been in operation for nearly 40 years. Even though it has never undergone a Major Rehabilitation, the structure is in fairly good condition. The project should continue to provide navigation service over the period of analysis with proper operation and maintenance, a moderate amount of major maintenance work, and a major rehabilitation focusing upon replacement of worn miter gates. The costs for rehabilitation of the locks and dam have been included in the Without-Project condition and are summarized below. The detailed schedule and cost estimate for the maintenance and rehabilitation work are presented in Section 7 of the General Engineering appendix.

Greenup Locks and Dam has a 110' x 1200' Main chamber and a smaller, 110'x 600' Auxiliary chamber. The Main chamber alone has sufficient capacity to handle current traffic levels, but the Auxiliary by itself does not. Therefore, when the Main chamber is closed for whatever reason, significant delays occur at the project. In order to minimize delays, aggressive measures are implemented during Main chamber closures, including a self-help program of extracting and repositioning barges during multi-lockage operations. Additionally, the Corps and industry work together to schedule closures within the year so as to minimize the costs for each. This pre-planning allows industry to re-schedule shipments around the closure period to the greatest practical extent.

Major Maintenance Requirements

The Most Likely Maintenance and Major Rehabilitation (M&MR) scenario was selected as part of the system-wide most likely Without-Project condition future in Section 7. This scenario was compared with a fix-as-fail (Baseline) maintenance scenario. The M&MR demonstrated the highest net benefits of the two scenarios. The following discusses the engineering and economic assessments for each of Greenup's individual components, and summarizes the findings that supported the selection of the M&MR as part of the Without-Project condition.

Major Maintenance

Structural Reliability Assessment. The Engineering Reliability analysis is discussed in detail in the General Engineering Appendix. Hazard values and consequences were developed for each component, the consequences being chamber closure duration, if any, and cost of repairs. This information is presented in the form of an event tree for each component at each chamber. **Table 13-1** summarizes the Engineering Reliability results for Greenup by lock chamber. Of the ten major components, six will need to be replaced in the Main chamber and five in the Auxiliary chamber. Due to the close proximity of the component replacement timing, it was determined that bundling the replacements into one major rehabilitation was more economical.

TABLE 13-1
Greenup Locks and Dam
Major Components Indicated for Replacement, by Chamber

Component	Chamber	
	Main	Auxiliary
Miter Gates	Replace	Replace
Lockwalls	---	---
Guardwalls	---	---
MG Monoliths	---	---
MG Sills	---	---
RT Culvert Valves	Replace	---
Hydraulic System	Replace	Replace
MG Machinery	Replace	Replace
CV Machinery	Replace	Replace
Electrical Systems	Replace	Replace

MG--miter gates

CV--culvert valves

Economic Evaluation. The Life Cycle Lock Model (LCLM) was used in this evaluation (see **Attachment 2, Life Cycle Lock Model** for a more detailed discussion of this model). Reliability analysis provides hazard values (probabilities of unsatisfactory performance), and

associated consequences of unsatisfactory performance. Consequences are in the form of repair costs (if any) and chamber closures (if any). These hazard values and consequences, along with a lookup table of industry delay costs by year and duration of closure, are the key inputs into the LCLM. The LCLM is a Monte Carlo type simulation model that accumulates economic costs (repair costs and industry costs) for a 50 year project life cycle in each iteration. Two repair schemes are evaluated: 1) fix-as-fail (FAF) and 2) planned replacement. Planned replacement refers to replacement of a major component in a specific year, so that LCLM runs are made for a series of replacement dates, so that the best year can be selected.

The result of successive iterations is a distribution of expected economic costs for a specific component at a specific lock chamber under either the FAF (fix-as-fail) or planned replacement. These costs can also be expressed as an expected life cycle present value cost for that component. **Table 13-2** compares expected present value costs under the two major maintenance alternatives at Greenup. Only the miter gates in the Main chamber were found to require near-term planned replacement. All remaining planned replacements occur in 2030. Planned replacements have the lowest expected costs for culvert valves and hydraulic systems in the Main chamber and miter gates and electrical systems in the Auxiliary chamber. The lowest cost alternative for the other components was FAF.

TABLE 13-2
Summary of Component Replacement Needs at Greenup
Present Value of Expected Life Cycle Costs
(thousands of \$1999, 6-7/8% discount rate, base year 2008)

	Major Component					
	Miter Gates	Culvert Valves	Hydraulic System	MG Machinery	CV Machinery	Electrical Systems
Main Chamber						
Fix-as-Fail	8,718.7	26.9	625.8	26.6	35.7	903.2
Planned Replacement in:						
2000	1,375.8	439.7	4,172.6	1,127.9	369.9	1,127.9
2002	1,332.4	---	---	---		---
2003	1,323.0	---	---	---		---
2004	1,317.6	---	---	---		---
2005	1,332.2	---	---	---		---
2010	2,084.4	227.1	4,250.7	1,073.1	197.6	1,229.2
2020	---	121.2	3,146.5	805.7	113.4	1,130.1
2030	---	64.6	2,246.8	580.8	71.5	1,048.4
Auxiliary Chamber						
Fix-as-Fail	269.3	---	38.3	1.7	3.0	227.6
Planned Replacement in:						
2000	645.0	---	247.8	397.1	219.5	397.1
2010	338.8	---	139.6	206.7	115.7	258.1
2020	172.1	---	91.6	107.2	61.0	207.3
2030	94.0	---	70.3	58.5	35.4	194.9

The M&MR scenario is a combination of the FAF and planned replacement of components. The replacement pursued is determined by what is economically justified by chamber and by component. When replacements are temporally proximate, they are bundled with the replacement of other components (like valves and culvert valve machinery). If this bundling reaches a specified dollar threshold, it is referred to as a major rehabilitation. The results of this analysis are incorporated into cost and closure matrices, which in turn are used as

inputs into the system economic model. The M&MR cost and closure matrix for Greenup is summarized in **Table 13-3** below, and the entire the matrix is provided in the General Engineering Appendix (Document GE). The matrix shows the schedule and costs for all major maintenance work, including major component replacement and major rehabilitations.

TABLE 13-3
Schedule of Major Maintenance Activities at Greenup L&D
(millions of \$1999)

Year	Main Cahmber			Auxiliary Chamber		
	Maint. Description	Days Closed	Repair Costs	Maint. Description	Days Closed	Repair Costs
2003	MGate-S	25	\$ 525	MGate-U	45	\$ 1,238
2004	SMR (MG, EG)	90	\$ -	-	-	\$ -
2005	SMR (MG Only)	60	\$ -	SMR (EG)	93	\$ 60
2007	CValve-Q	-	\$ 990	CValve-R	45	\$ 945
2010	-	3	\$ 60	MGate-V	45	\$ 1,238
2016	MGate-U	55	\$ 1,448	-	10	\$ 210
2021	MGate-V	45	\$ 1,238	-	-	\$ -
2023	-	-	\$ -	MGate-U	45	\$ 1,238
2027	-	10	\$ 210	CValve-R	50	\$ 1,050
2030	MGate-U	55	\$ 1,448	SMR (MG, Elec)	60	\$ -
2031	CValve-P	-	\$ 990	SMR (MG Only)	70	\$ 210
2036	MGate-V	45	\$ 1,238	-	-	\$ -
2046	MGate-U	48	\$ 1,298	-	10	\$ 210
2047	CValve-P	-	\$ 990	CValve-R	45	\$ 945
2048	CValve-Q	10	\$ 1,200	MGate-U	45	\$ 1,238
2051	MGate-V	45	\$ 1,238	-	-	\$ -
2052	-	-	\$ -	MGate-V	45	\$ 1,238

Notes:

- 1/ MG -- miter gate, EG -- emergency gate
- 2/ SMR -- component replacements bundled into a major rehabilitation, components in parentheses)
- 3/ Where components are named, a replacement has been scheduled.

Maintenance Requirements. The normal operation and maintenance (O&M) costs for continuing the existing project are estimated at \$3.59 million annually (refer to **Table 13-4**). These costs provide for staffing the project, routine operation and maintenance activities, and dredging in the lock approach. Cyclical maintenance cost \$0.77 million on an average annual basis, and random minor repairs are projected to cost another \$0.25 million. The Main chamber undergoes a major rehabilitation in 2004-2005 that costs \$19.1 million. The Auxiliary chamber undergoes a major rehabilitation in 2005 and again in 2030-2031 at a total first cost of \$22.1 million, or an average annual cost of \$0.76 million. A \$24.8 million dam rehabilitation is scheduled for the years 2043 – 2045. Total average annual capital costs of \$2.5 million, O&M costs of \$4.98 million, and \$1.5 million in transportation impacts make-up the \$9.03 million in total annual costs.

Operational Alternatives

Nonstructural traffic management measures, within the current purview of the Corps of Engineers and offering opportunities for more effective use of the existing Greenup project, are considered as candidate elements for inclusion in the Without-Project condition. Best-practice lockage policies and helper boats (i.e. self-help) are especially effective during high congestion situations at locks where double-cut tow operations are necessary – situations typical of a Main chamber closure at Greenup. The average annual cost of this operation is estimated to be \$0.15 million. Six-up / six-down policies and helper boat operations are both employed as standard practice during Main chamber closures. As a result, both of these non-structural measures are assumed to continue into any Without-Project future condition. A form of traffic re-scheduling is also practiced during closures of the Main chamber.

As mentioned earlier, the Corps and industry work together to plan and schedule maintenance closures so as to minimize the costs for each. This pre-planning allows industry to re-schedule shipments around the closure period to the greatest practical extent. Tow arrivals are observed to diminish once delays and tows in queue reach a certain level during long duration Main chamber closures. This acts to reduce the average amount of time each tow sits in queue, reducing delay costs for the tow operators; however, chamber capacity is not increased. Discussions with shippers and towing companies indicate that while lock proximate delays and delay costs are reduced, shippers and/or producers are faced with cost increases elsewhere. Stockpiles and inventories are increased, production is re-dispatched to less efficient plants, short-term productive capacity is added or short-term alternative transportation procured. The capacity of the production and distribution system has not been increased through this re-scheduling; increased costs have merely been re-distributed throughout the system. It is assumed that shippers and carriers have made economically rational decisions in re-distributing these costs; therefore, re-scheduling as currently practiced is retained as part of the future Without-Project condition. Government-directed scheduling of tow arrivals at locks is not currently within the authority of the Corps of Engineers and was not considered as a possible component of the most likely Without-Project condition.

Navigation Benefits and Conclusion

For the traffic using Greenup, the transportation cost savings (benefits) over the period of analysis are estimated at \$1352.4 million annually, far in excess of the \$7.5 million in average annual project costs for major maintenance, operations, and routine maintenance, and implementation of a helper boat program. Given this and the fact that no other nonstructural measures to improve lock efficiency were identified, the existing condition described in the preceding paragraphs is selected as the most likely without-project future condition at Greenup Locks and Dam.

ECONOMICS OF THE WITHOUT-PROJECT CONDITION

The annual benefits, annual costs, and net benefits (Greenup traffic only) for continuing the existing Greenup project are presented in **Table 13-4**. Total average annual benefits are estimated at \$1,352.4 million. Total average annual operations and maintenance costs are \$7.5 million. Industry delay costs incurred during unplanned component replacements are estimated at \$1.51 million on an average annual basis. These two costs total to \$9.03 million. Comparing total annual benefits and annual costs yields net annual benefits for the without-project condition of \$1,343.4 million.

Traffic demands are generally accommodated over the period of analysis, except during those times when the Main chamber is closed. During closures, traffic demands and traffic accommodated can be seen to diverge in **Figure 13-1** below. During normal operations, traffic is diverted to alternate modes in very small amounts and only during the last 25 years of the analysis period. Main chamber closures tend to have their greatest effect on waterway operating costs, rather than causing large diversions of demand to other transportation modes.

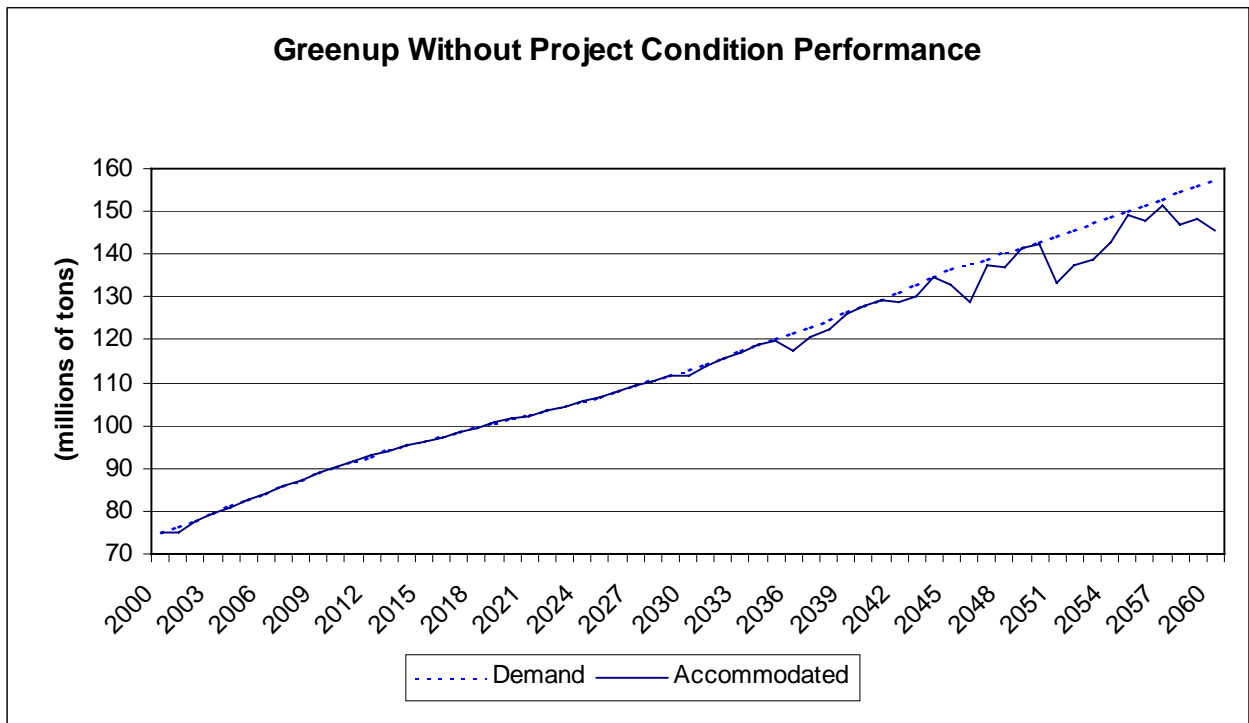
TABLE 13-4
Annual Benefits, Costs and Net Benefits
(millions of \$1999, 6-7/8% discount rate, base year 2008)

Item	Amount
Annual Benefits 1/	\$ 1,352.40
Annual Costs	
Normal O&M	\$ 3.59
Dam Rehabilitation (\$24.8 over years 2043-45)	\$ 0.15
Dredging	\$ 0.23
Main Chamber	
Rehabilitation (\$23.3 over years 2004-5)	\$ 1.63
Cyclical Maintenance (\$16.9 in various years)	\$ 0.43
Random Minor (\$2.8 in various years)	\$ 0.18
Auxiliary Chamber	
Rehabilitation (\$26.2 over 2005 & 30-31)	\$ 0.76
Cyclical Maintenance (\$10.0 in various years)	\$ 0.34
Random Minor (\$2.2 in various years)	\$ 0.07
Helper Boats	\$ 0.15
subtotal	\$ 7.52
Transportation Impacts	\$ 1.51
Total Annual Costs	\$ 9.03
Net Annual Benefits	\$ 1,343.37

1/ Only those transportation benefits realized by traffic using Greenup Locks and Dam.

Please note that the discount rates and work-cost estimates used in Sections 13 and 14 of this report (the Without- and With-Project screening sections) use the 6-7/8% interest rate and cost estimates available in late 1999 (at the time of the screening). However, the final With-Project and incremental benefit-cost analyses in Section 15 use slightly updated cost estimates for the final plan (developed in January 2000) and the most recent 6-5/8% Federal discount rate. These recent minor cost and interest changes, while important in calculating the most up-to-date benefit-cost ratios, should not affect the results of the screening (plan comparison) exercises in Sections 13 and 14.

FIGURE 13-1



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SECTION 14

IDENTIFICATION of ALTERNATIVE IMPROVEMENT PLANS

This section discusses the development and screening of With-Project alternative plans for addressing the problems and needs at Greenup Locks and Dam. Alternatives were formulated in a two-stage process. First, a broad range of alternatives was considered in order to identify potential measures that would make future locking conditions at Greenup more efficient. Options considered which had practical application and reasonable development costs were carried forward for a more detailed evaluation based on development costs, navigation benefits, and environmental impacts. Costs and designs were developed more fully for those alternatives carried forward to the final screening. Screening at this last stage produced the final plans for detailed engineering and design and identification of the NED plan.

ALTERNATIVES CONSIDERED (INITIAL SCREENING)

In the initial review, a broad range of plans was considered. As discussed in Section 5, these alternatives were weighed against the planning objectives, namely:

- Ensure future navigability
- Improve navigation efficiency
- Conserve fish and wildlife resources

Each of several types of alternatives were considered, as discussed below.

New Locks

A totally new locks and dam project replacing Greenup with twin 1200' chambers would meet navigation needs from all standpoints: 1) structural reliability, 2) ability to efficiently handle traffic during closures of the Main chamber, and 3) ability to efficiently handle future, high volumes of traffic in the later years if needed. A new project could be constructed either upstream or downstream from the present project. An upstream project would lower the pool resulting in a shallow channel, and a downstream project would raise the pool between the old

and new dams. A new project would have significant economic, environmental and social impacts.

A totally new replacement project with a 1200' Main and 600' Auxiliary would provide a more structurally reliable project, but only partially meet the needs. Any closures of the Main chamber would require all traffic to use the 600' lock. This would impose heavy delay costs on industry and congestion associated with traffic growth would still be a problem in later years.

An additional 1200' chamber (a third chamber) at the existing site results in a project with twin 1200' chambers and a backup 600' chamber (which would be used during closures of one of the 1200' chambers). This configuration has the ability to efficiently process traffic during closures of either 1200' chamber, as well as handle potentially higher volumes of traffic during the later years of the project. The Greenup landward site, unlike Myers' landward site, has to contend with the existing bridge piers. Construction of a 1200' lock would impact nearly 2 miles of riverbank and result in 6 million cubic yards of excavation to be disposed of on vegetated land at the project.

Lock Extensions

Both a 200' and a 400' extension of the existing Auxiliary chamber were considered. These extensions would result in projects with a 1200' Main chamber and either an 800' Auxiliary or a 1000' Auxiliary, respectively. Neither alternative would efficiently process traffic during closures of the Main chamber. In 1998, 65% of the tows arriving at Greenup would have to double-cut in a 1000' chamber, and 75% would have to double-cut in an 800' chamber, resulting in a continuation of serious delays and industry costs during Main chamber closures. Furthermore, these extensions are not practicable from an engineering standpoint. Culverts are located in the middle wall monoliths where the gate recesses would have to be placed. The affected middle wall monoliths would have to be taken out and rebuilt to accommodate the gate recesses. This would probably close the entire river in this vicinity for a year or more. Extending the Auxiliary chamber by anything less than 600' would have major effects on waterway traffic.

A 600' extension of the existing Auxiliary chamber results in a project with two 1200' chambers.¹ The twin 1200' configuration has the capability to efficiently process traffic during closures of either 1200' chamber, as well as handle potentially higher volumes of traffic during the later years of the project. Future major maintenance would still be required for major components at Greenup to keep the project operating efficiently, including rehabilitation of the Main lock and the navigation dam.

Small Capital Improvements

Two emergency mooring cells presently are located upstream of the Greenup project. While there is some industry and public interest in installation of mooring buoys or similar cells

¹ These are nominal lengths indicating the longest vessel that could safely use the facility. Pintle-to-pintle length of the extended chamber is 1320 feet at Greenup.

downstream of the project, this small-scale improvement does nothing to reduce approach times and increase efficiency of the project. However, there remains the potential for buoys or cells to provide significant environmental benefits, and this aspect is addressed in the environmental appendix.

Guardwall and middle wall extensions in the upper pool of the existing project have the potential to significantly reduce interference between tows concurrently using the Main and Auxiliary. Minimizing interference has the potential to reduce lock delays when traffic reaches the level where both chambers are highly utilized. Nevertheless, wall extensions are not expected to provide the capacity expansion needed to handle future traffic volumes during the later years of the project, nor will they reduce delays when the Main chamber is closed for maintenance (when interference between chambers is not the main problem).

A Miter Gate Quick Changeout System (MGQCS) could be used to shorten closure durations for maintenance or accident requiring miter gate removal. This alternative requires a towboat equipped with a heavy-duty crane, a specially equipped barge, gates modified for lifting by a crane, an on-site set of additional gates, and an assembly/storage/staging area for these gates. The MGQCS allows maintenance closures involving the chamber gates to be significantly shortened, easing the closure-related delay costs experienced by industry.

Non-Structural Measures

Locks nearing their practical capacity limits can benefit from a traffic-scheduling program that assigns tow arrival times. The goal of such a scheduling program is to reduce delays and their associated costs. However, there are some critical limitations to scheduling. Shipments must still occur, forcing shippers to either re-route these moves to a more expensive transportation mode, re-dispatch their production to less efficient plants, or re-schedule these shipments for another time. Re-scheduling shipments is more costly as well. The shipper may have to pay higher, short-term costs for waterway service, and stockpiles will either have to be built-up or drawn-down prematurely at an additional cost to the shipper, which in turn may involve additional handling costs. In short, the capacity of the production and distribution system is not increased through a scheduling program during Main chamber closures; increased costs are merely re-distributed throughout the production and distribution system. Scheduling does not address the need for additional Auxiliary chamber capacity and is unable to alleviate the adverse economic impacts of closure.

A congestion lockage fee would be used to influence the shipper with very marginal savings for barge shipments to shift their traffic to an alternate overland mode, thereby reducing the amount of lock congestion. Thus it serves as a program for rationing lock use to those movements with the highest marginal savings. The result would be an increase in total rate savings net of delay costs for shippers that continue to use the waterway. This alternative would reduce traffic queues and therefore industry costs at the locks.

Summary of Initial Screening

The initial screening retained some alternatives and eliminated others based on navigation conditions, development impacts and other qualitative criteria. The results of the initial screening are discussed below and summarized in Table 14-1.

Non-Structural Measures

Helper boats increase the efficiency of Auxiliary lockages but do not reduce the amount of time this lock must be used. Consequently helper boats have not been evaluated as a separate alternative, but are part of the Greenup WOPC. Congestion fees could influence shippers with marginal savings to leave the waterway and use other modes of transport. The result would be a reduction in lock congestion and traffic queues, and an increase in net rate savings for those shippers who continue to use the waterway. This alternative has been retained for further evaluation.

Traffic scheduling could be used to reduce delays at locks that are at or near capacity. However, the larger and more complex the production and distribution systems for the commodities being shipped, the more difficult it is to reduce overall transportation cost. Also, owners and shippers are faced with other cost increases, such as additional stock piling, shifts in production locations and use of more costly transport modes. Since formal traffic scheduling would not increase lock capacity nor significantly reduce the overall cost of waterway transportation in the mid-Ohio navigation system, it has been dropped from further consideration.

Small Capital Improvements

A miter gate quick changeout system (MGQCS) would reduce lock closure duration for any maintenance or accident requiring gate removal thereby reducing industry delay costs. Because of its obvious benefits and relative low cost, this alternative has been retained for further evaluation.

Extension of the middle or guard walls in the upper approach at Greenup (in lieu of other improvements such as actual chamber lengthening) may reduce interference when traffic reaches a level such that both the Main and Auxiliary chamber is being heavily used. Guardwall extensions, however, would not reduce delays when the Main chamber is closed for scheduled maintenance or repair. Therefore, this alternative was not retained for further investigations.

TABLE 14-1. GREENUP L&D: INITIAL SCREENING OF ALTERNATIVES

Alternative	Maintenance Closures	Auxiliary Capacity	Development Cost	Environmental Impacts	Social-Cultural Impacts	Future Nav. Needs	Conclusion
NON-STRUCTURAL MEASURES							
Congestion Fees	Does Not Reduce Closure Frequency/Durations	Reduces Delays by Lowering Traffic Demands – no effect on lock capacity (throughput)	Lowest Cost	Min. Impacts	No Impacts	Partially Meets Needs	Retained
Traffic Scheduling	Does Not Reduce Closure Frequency/Durations	Slightly Decreases Aux. And Overall Project Delays – no effect on capacity	Lowest Cost	Min. Impacts	No Impacts	Does Not Meet Needs	Dropped
SMALL CAPITAL IMPROVEMENTS							
Wall Extension	Does Not Reduce Closure Frequency/Durations	Slightly Increases Lock Capacity by Reducing Interference	Low Cost	Min. Impacts	No Impacts	Does Not Meet Needs	Dropped [1]
Miter Gate Quick Changeout System	Reduces Closure Durations	Slightly Increases Overall Capacity by Reducing Closure Durations	Low Cost	No Impacts	No Impacts	Partially Meet Needs	Retained

[1] Evaluated as part of the Without Project Condition

TABLE 14-1 (continued). GREENUP L&D: INITIAL SCREENING OF ALTERNATIVES

Alternative	Maintenance Closures	Auxiliary Capacity	Development Cost	Environmental Impacts	Social-Cultural Impacts	Future Nav. Needs	Conclusion
NEW LOCK CHAMBERS							
Replacement Project, 1200' & 600' Locks	Reduces closure frequency and durations	Increases effective capacity by reducing closures	Excessive Cost	Major Impacts	Major Impacts	Partially Meets Needs	Dropped
Replacement Project Chamber, Twin 1200' Locks	Reduces closure frequency and durations	Maximizes capacity, with two large locks	Excessive Cost	Major Impacts	Major Impacts	Meets Needs	Dropped
Third 1200' Chamber, Existing Site	Reduces closure frequency and durations	Maximizes capacity at existing site	High Cost	Major Impacts	Minor Impacts	Meets Needs	Dropped
LOCK EXTENSION							
Extend Auxiliary Additional 200' – 400'	Does not reduce closure frequency/durations	Slightly increases Aux. capacity by eliminating some double lockages	High Cost	Minor Impacts	Minor Impacts	Does Not Meet Needs	Dropped
Extend Auxiliary, Additional 600'	Does not reduce closure frequency/durations	Increases Aux. capacity by eliminating all double lockages	Moderate Cost	Minor Impacts	Minor Impacts	Meets Needs	Retained

New Locks

A new locks and dam project either upstream or downstream from the Greenup Dam would provide excellent navigation conditions and meet all future needs. The cost of a new project at any location, however, is excessive when compared to the cost of providing similar lock capacity at the existing site. The adverse environmental and social impacts of such a major development also would be significant. Because of these reasons, the new project alternative was dropped from further consideration. Likewise, a new 1200' foot lock could be constructed at Greenup, landward of the existing Auxiliary chamber. The location of a pier supporting the new highway bridge, and the significant amount of riverbank excavation required, add to the construction difficulties and increase the cost. The estimated cost of \$300-\$350 million for a new 1200' lock is high when compared to the cost of other options for reducing lock delays at the project. Consequently, this alternative was not retained for further consideration.

Lock Extensions

The Auxiliary chamber at Greenup could be lengthened by extending the chamber walls downstream and adding new upper and lower guide walls. The extensions could vary from 200 feet up to 600 feet, which would provide an Auxiliary lock 1200'x110'. Any extension less than 600 feet would still require double lockages when the Main chamber is closed. The extended chamber could continue to use the existing filling and emptying system (F/E), which would be somewhat slower, or construct new culverts, which would be faster but more costly. Extension of the Auxiliary lock 600 feet with the option of constructing F/E culverts now or at a later date would meet future navigation needs at much less cost than for a new lock. This alternative has been retained for further investigations.

ALTERNATIVES EVALUATED (FINAL SCREENING)

One non-structural alternative (congestion fees), one small capital investment alternative (MGQCS), and one structural alternative (a 600' extension of the existing Auxiliary lock) have been retained for evaluation following the initial screening. The criteria used for this final evaluation and screening include costs and net benefits, environmental impacts, and future navigation needs. The results of this evaluation and screening are discussed below and summarized in Table 14-2.

Congestion Fees

A series of congestion fees were evaluated at different times in the 50-year project life. Analyses indicated that no one fee was best, but rather they varied each year based on traffic, closures, etc. In a situation where daily traffic levels have nearly reached capacity, congestion fees have been successful in moving marginal movements off the waterway, at an advantage to

the entire system. Congested situations are projected to occur during Main chamber closures, but not on a daily basis. Current non-structural measures employed by industry in these situations, particularly helper boat operations and traffic re-scheduling (making shipments ahead of or after lock closures), keep delays from reaching extremely high levels where congestion fees might be more effective-.

Miter Gate Quick Changeout System (MGQCS)

A miter gate quick changeout system (MGQCS) would be used to shorten closure durations for any kind of maintenance or accident requiring gate removal. Operations and Engineering personnel estimated that a closure for gate maintenance could be reduced from 45 days to 15 days at Greenup once the system is fully implemented. This alternative requires a derrick boat with heavy-duty crane, gates modified for lifting by crane and an on-site set of additional gates. This alternative allows maintenance closures involving lock chamber gates to be significantly shortened, reducing the closure-related delay costs experienced by industry. The cost of providing one pair of additional gates, an onshore gate assembly pier, quoin modifications, and other incidentals for this plan is estimated to be approximately \$7.1 million dollars.

Auxiliary Lock Extension

A 600' extension of the Auxiliary chamber results in a project with twin 1200' chambers. This lock configuration would efficiently process traffic during closures of either the existing Main lock or the extended Auxiliary lock. It is capable of handling a higher volume of traffic that could develop during later years of the project. Four different design variations of this alternative have been evaluated in detail. The design variations relate to different options regarding the filling and emptying system for the extended lock. Pertinent aspects of the plans are summarized below and design details and cost estimates are provided in the Engineering Appendix.

- Plan 1. The Auxiliary chamber would be lengthened to 1200' by extending the chamber walls and the upstream and downstream guide and guard walls. The longer guide walls would provide sufficient landing for 1200-foot tows. The extended chamber walls would accommodate construction of a new downstream miter gate bay. The existing filling and emptying (F/E) system would be used for the extended chamber resulting in longer filling and emptying times. If any improvements to the F/E system would be required in the future, then major modifications including lengthy closure of the extended Auxiliary chamber would be necessary.
- Plan 2. This plan would include all the features of Plan 1 plus the following:
 - - A culvert in the extended lower land wall.
 - - Outlet culvert and emptying valve which would allow for faster emptying of the extended chamber.

- - New laterals in the extended chamber bottom to permit faster emptying time for the lock. This plan would have dual emptying systems, and a new filling system could be added in the future, if economically feasible, with minimum impacts to lock traffic.
- Plan 3. This plan has all the features of Plan 2 with the addition of a supplemental filling system. A new “wrap-around” culvert would be constructed from a new intake structure to the extended chamber land wall. This plan includes a fully functional F/E system resulting in F/E times comparable to other Ohio River locks and results in a full service lock.
- Plan 4. This plan has all the features of Plan 3 except that the new filling and emptying system would be constructed in two phases. The first phase would be essentially Plan 2, the basic lock extension with certain modifications that would permit the addition of a new filling culvert at some future date. The second (future) phase would involve construction of the intake structure and wrap-around filling culvert. After completion of this phase the plan would be nearly identical to Plan 3. Future construction would not be undertaken until traffic needs would justify a more efficient filling system.

Plan 1 would not have fully functional filling or emptying systems. Therefore, the time required to fill and empty the longer chamber is unknown at this time, but preliminary testing indicates that it would at least double the time required to fill and empty the existing 1200' chamber. Plan 2 has a fully functional emptying system, but not filling system. Therefore, Plan 2 would empty as fast as a standard lock, but filling would take considerably longer as discussed for Plan 1. How efficient the use of the original filling and emptying (F/E) system would be for the extended chamber cannot be fully determined until the next study phase (PED) and requires the use of physical models at WES. If the existing F/E system can be used, the development cost for the lock extension will be less than if a totally modified F/E system is necessary. Since all the detailed design data necessary to optimize the F/E system is not available for this feasibility analysis, Plan 3 has been used for the purposes of formulating final alternatives, as a plan that typically represents the desired lock extension alternative. Even without the benefit of physical model results, there is confidence that the modified F/E system included in Plan 3 will perform satisfactorily for the extended lock.

TABLE 14-2. GREENUP L&D: FINAL SCREENING OF ALTERNATIVES

Alternative	First Cost	Total First Cost [1]	Incremental Annual Cost	Incremental Annual Benefits	Incremental Net Benefits	Environmental Impacts	Future Navigation	Conclusion
Without-Project Condition	0	66.0	N/A	N/A	N/A	N/A	N/A	N/A
600' Aux. Extension	168.0	233.5	10.3	24.6	14.3	Minor Aquatic & Riparian	Meets Needs	Highest Net Benefits – Retained
Miter Gate Quick Changeout System (MGQCS)	7.1	73.2	0.5	8.6	8.1	No Impacts	Partially Meets Needs	Low Net Benefits – Dropped [2]
Congestion Fees	1.0	67.0	1.0	6.7	5.7	No Impacts	Partially Meets Needs	Low Net Benefits – Dropped

[1]Includes a \$24.7 million dam rehabilitation in 2043-2045, a \$19.1 million Main chamber rehabilitation (WOPC occurs in 2004-05; With-project occurs in 2008-09), and an Auxiliary chamber rehabilitation occurring in 2030-31 (WOPC cost \$22.1 million; With-project cost \$21.6 million).

[2] Dropped as separate alternative, but evaluated later as part of lock extension alternative see **Table 14-3**).

SUMMARY OF ALTERNATIVES EVALUATED

Congestion fees only partially address the planning objective of efficiently passing traffic at Greenup during lock closures. While congestion fees do help in reducing delays during closures of the Main chamber, industry costs (delay costs plus the fee) remain high for tows still using the lock, and marginal movements pushed off the system must pay the higher overland rate. Even though the plan has positive net benefits it is not considered a viable alternative because of the problems of implementing a congestion fee program and its inability to fully address the most pressing needs at Greenup.

A miter gate quick changeout system (MGQCS) would allow maintenance closures involving lock gates to be significantly shortened, thereby reducing delay cost experienced by industry. This plan partially meets study objectives by reducing the duration of lock closures involving gate replacement, but does not fully address total delays related to lock closures. Therefore, it is not considered to be a viable stand-alone alternative, even though it has positive net system benefits. However, since this option does provide significant efficiency gains it has been included as a component in the 600' lock extension plan.

A 600' extension of the Auxiliary lock at Greenup results in a project with two 1200' foot locks. This alternative meets the identified navigation needs and satisfies the planning objectives. It is the most viable alternative that is implementable. The estimated costs of the lock extensions options vary from \$142 million to \$175 million, depending on the extent of modifications to the existing filling and emptying (F/E) system. Reliance partially or totally on the use of the existing F/E system for the extended lock will result in much longer F/E time. Inefficiencies that will result cannot be fully clarified until PED studies are complete. Consequently, for the purposes of selecting the final alternatives in the feasibility study, the 600' lock extension identified in the Engineering Appendix as Plan 3, has been used to best represent the cost and operational performance of the desired lock extension alternative. Plan 3 includes a fully functional F/E system and has an estimate cost of \$174.8 million, which includes the MGQCS (See Table 14-3). Since the lock extension plan is the only viable option, with the greatest net benefits among the final alternatives, it is the NED plan, and has been designated the tentative selected plan.

TABLE 14-3. Greenup Locks and Dam
Annual Costs and Benefits for Intermediate Alternatives
(millions of October 1999 dollars, 6 7/8% discount rate, base year 2008)

Alternative	First Cost	Incremental	Average	Annual	BCR
		Costs	Benefits	Net Benefit	
Congestion Fee	1.0	1.0	6.7	5.7	6.7
Gate Changeout System	7.1	0.5	8.6	8.1	16.4
600' Auxiliary Lock Extension 1/	174.8	10.8	25.7	15.0	2.4

1/ Includes MGQCS

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EVALUATION OF FINAL PLAN (GREENUP L&D)

This section provides a detailed evaluation of the final alternative plan in relation to the Without-Project condition. The evaluation process has focused on the effects of traffic delays associated with maintenance closures of the Main lock, the impacts of extension of the Auxiliary at the project site, and the analysis of benefits and costs for the final plan. The performance of the final plan is examined in terms of projected traffic, system traffic effects, and total system rates-savings. It is estimated that the year 2008 would be the earliest probable date by which any lock extension plan could be completed and operational. However, for purposes of economic analysis and impact assessment, the analysis period extends from 2000 to 2058, in order to capture construction impacts (2000-2008) and variations in lock closure schedules between the Without- and With-Project alternatives. A sketch showing the layout of the selected plan is shown in Figure 15-1.

ECONOMIC IMPACTS

All economic values are expressed in October 1999 dollars. Previous sections detailing the economic screening of alternatives used October 1999 dollars and a discount rate of 6 7/8%. After the screening, the discount rate was lowered to 6 5/8%, and various late revisions were made to the cost estimates for the final (selected) plan. The current rate (6 5/8%) and revised cost data are used in the economic analysis of the final plan presented in this section, and in the sensitivity analyses presented in Section B-12 of the Economics Appendix.

Traffic

The volume of traffic that could move through Greenup over the analysis period with the final lock extension plan and the WOPC is presented in Table 15-1.

TABLE 15-1. Greenup Locks and Dam: Traffic Accommodated by Final Plan
(millions of tons)

Year	Demand Tonnage	Accommodated Tonnage 1/	
		Without Project Condition	600' Extension Plan
2000	74.9	74.8	74.8
2010	90.5	90.4	90.4
2020	101.6	101.6	101.6
2030	112.9	111.7	112.8
2040	127.8	127.7	127.7
2050	142.8	142.4	142.4
2060	157.3	147.8	150.6

1/ Closures assumed.

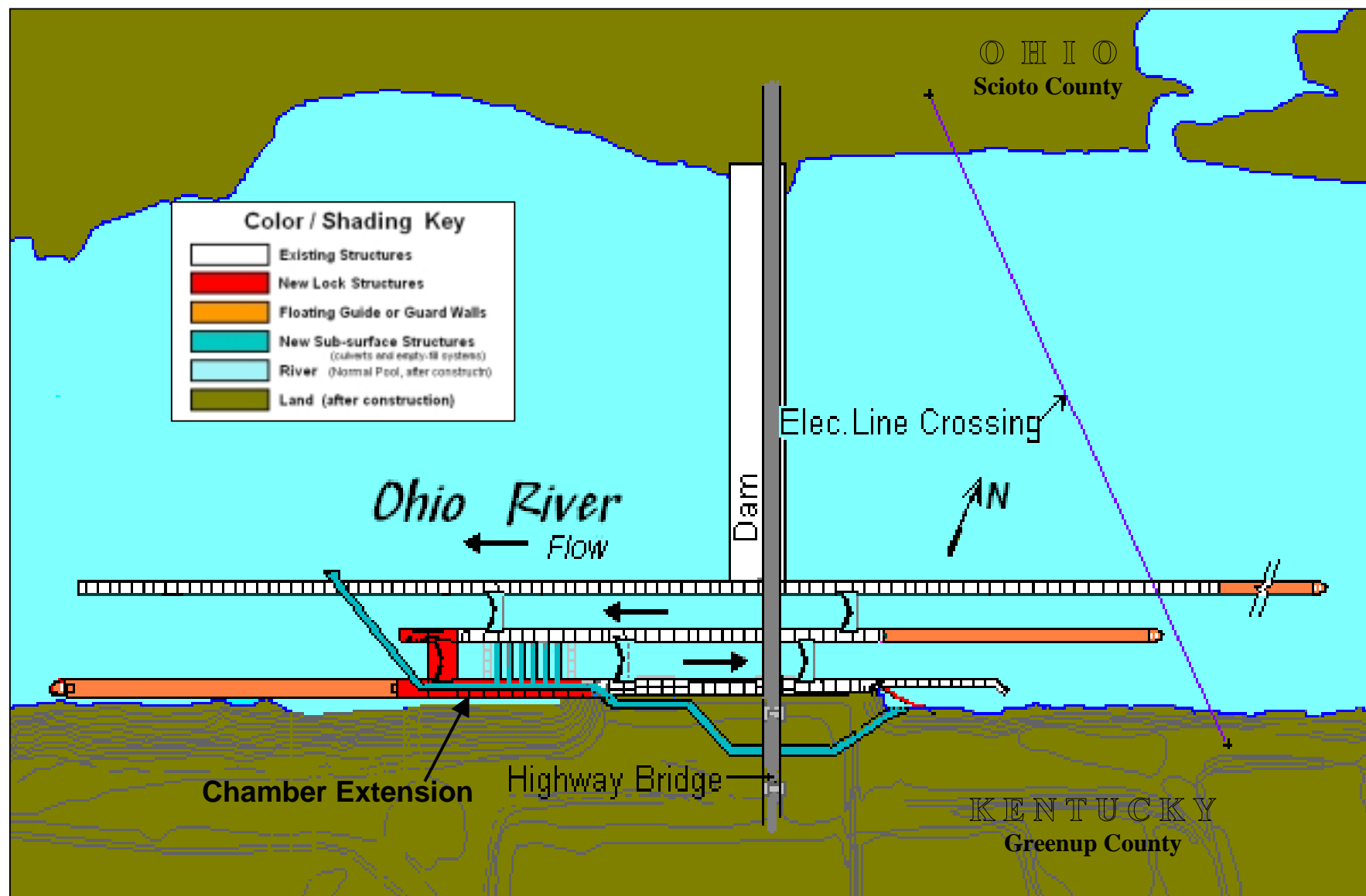


Figure 15-1. Selected (N.E.D.) Plan. Extend Greenup Auxiliary chamber to 1200' length.

System Impacts

Since project traffic capacity is not a significant problem at Greenup L&D, and since the present locks can accommodate most of the projected traffic through 2060, there is expected to be very little if any impact on Ohio River system traffic due to the improvements being considered. Using the most-likely traffic projections, there would be a slight increase in traffic moving on the Ohio River system in 2060. Only with the high growth scenario would there be significant traffic increases resulting from an extension of the Greenup Auxiliary lock, including an increase in incremental system benefits. The system traffic accommodated by the final plan is displayed in Table 15-2.

TABLE 15-2.
Ohio River System Traffic Accommodated by Final Plan
(million of tons)

Year	Demand Tonnage	Accommodated Tonnage 1/ Without Project	
		Condition	600' Extension Plan
2000	275.7	275.6	275.6
2010	324.4	324.2	324.2
2020	354.4	343.2	343.2
2030	385.1	381.7	382.9
2040	422.7	419.2	419.2
2050	459.5	442.5	442.5
2060	493.2	465.1	472.1

1/ Closures assumed.

ENVIRONMENTAL IMPACTS

The following sub-sections provide a description of environmental impacts for the final plan. A comparative summary of this information is provided in Table 15-8 at the end of this section.

Aquatic and Terrestrial

The lock extension plan would have direct impact at the project construction site on environmental resources including aquatic and riparian habitats. Dredging and other excavation to extend the lockwalls would result in the removal or disturbance of substrate habitat along with an increase in turbidity levels. Blasting necessary to remove sections of concrete lock walls would result in some fish kills and the suspension of concrete fines and other riverbed material.

Suspended material could drift downstream far enough to impact spawning areas and suspected mussel beds. Clearing of the construction work area and disposal of excavated material would result in losses of terrestrial habitat such as riparian forest, open field and river

bank. The estimated impacts of the lock extension improvements on environmental resources in the Greenup project area are summarized in Table 15-3.

TABLE 15-3.
Greenup Locks and Dam
Lock Extension Plan - Habitat Losses

Habitat Type	Estimated Acreage Loss	Description of Impacts
<i>Terrestrial</i>		
Riparian Forest	47 acres	Landclearing for dredge spoil pile, batch concrete plant, construction laydown and access.
Open Field	83 acres	Landclearing for construction laydown and access
River Bank	9 acres	Construction of landwall extension, filling culvert, construction access
Total Terrestrial	139 acres	
<i>Aquatic</i>		
Backwater	17 acres	Dredging, rock excavation and blasting for landwall extension
Upper Riverine	1 acre	Dredging, rock excavation and blasting for filling culvert
Lower Riverine	0 acres	No direct habitat losses anticipated
Total Aquatic	18 acres	

Recreation

Some recreation facilities involving primarily fishing access would be impacted and their use disrupted during construction of the lock extension plan. Full replacement of the affected facilities to current design standards is included in the lock extension plans.

Endangered Species

There are no known Federally-listed threatened or endangered species in the area that would be impacted by construction of the lock extension plan

Social Impacts

All real estate impacted by the construction of the lock extension are Federal project lands at Greenup Locks and Dam. There are no private residences or any other structures that would be acquired or in any way impacted by the lock extension plans for Greenup.

Cultural Resources

There are several recorded archeological sites in the general area designated for material disposal, and one located near the downstream construction area. Several of the sites are in areas of prior disposal and are buried. Any site that could be impacted by the lock extension plans will be thoroughly investigated and closely monitored during construction, and the artifacts will either be recovered or preserved.

Ohio River System Environmental Impacts

There is potential for system-wide traffic impacts associated with navigation improvements. Such impacts occur whenever Federal actions provide for increased navigation traffic throughout the river system. However, for Greenup, economic projections indicate there will be continued traffic growth both with and without the recommended improvements. The potential for system-wide environmental impacts, therefore, is not anticipated because future traffic levels are expected to be essentially unchanged.

The potential exists for some synergy between the recommended improvements at Greenup and potential improvements at other system navigation projects which could result in increased traffic at Greenup. For example, approximately one-third of the movements transiting the upper Ohio River projects (Emsworth, Dashields, and Montgomery) also moves through Greenup. This could suggest that future traffic at these projects would be influenced by improvements at Greenup. However, since Greenup now has the capacity to handle all forecasted traffic, no synergistic traffic increase would be anticipated for the system at large because of recommended improvements at Greenup. Also, future traffic demands associated with potential improvements at upper river projects are not expected to be impacted by any improvements at Greenup since traffic common to all these projects would remain relatively constant with or without any changes at Greenup. In summary, current traffic analyses indicate that improvements at Greenup would not contribute to increased river traffic that may result from potential improvements at any other project within the system, and cumulative navigation traffic impacts to the Ohio River ecosystem, therefore, are not expected.

Environmental Mitigation

The environmental mitigation plan has two components – one addresses terrestrial impacts and the second addresses aquatic impacts.

The terrestrial component is based on restoring terrestrial habitat values in all three baseline habitat types identified in Table 15-3. Under this alternative, approximately 68 acres of Riparian Forest habitat, 62 acres of Open Field habitat, and 9 acres of River Bank habitat would be restored in accordance with the proposed habitat designs discussed in the EIS. The proposed acreages for Open Field and Riparian Forest habitats are based on a division which optimizes available forested habitat within the limits of total site acreage while minimizing losses to Open Field species. River Bank habitat is held constant at 9 acres due to O&M restrictions.

Implementation of this feature would essentially continue the baseline condition while optimizing the value of replacement habitats within existing site-acreage limits.

The aquatic component consists of construction of two 1,000-foot parallel dikes in the restricted tailwater zone below the Greenup Dam. Therefore, construction of the dikes represents a compensating, rather than a rectifying mitigation alternative, essentially substituting habitat values attributable to the dikes for lost values associated with impacts to Backwater and Upper Riverine habitats. The dikes are to be continuous structures constructed of rock and rubble excavated as part of construction of the lock extension. Final height and configuration of the dikes will be determined at a later phase in design, pending the outcome of site-specific hydraulic modeling studies and operational discussions regarding safety and maintenance access issues. Additional habitat values are gained for the river bank stabilization/mitigation described in the Environmental Appendix.

System mitigation includes construction of T-dikes and notch dikes for compensation of fish mortality and fish reproduction impacts. In general, the dikes are constructed of stone material positioned perpendicular from the riverbank into the main river channel. The T-dikes are approximately 50 feet long with a 3 to 1 slope, and constructed at a minimum of 10 feet below normal pool elevation. The notch dikes are approximately 70 feet long with a 3 to 1 slope, and constructed at a minimum of 10 feet below normal pool elevation. The estimated cost of the entire mitigation plan for Greenup lock extension is \$3.6 million (see Table 15-4).

ECONOMIC ANALYSIS

The costs and benefits for the final lock extension plan at Greenup are summarized in this section. The costs and benefits for the plan represent the incremental differences between the With-Project condition (new construction) and the Without-Project condition. The analyses have been completed using a 50-year period of analysis (project economic life). The base year for economic analysis is 2008, the earliest completion date for a lock extension project. Benefits and costs are both expressed in October 1999 prices.

First Cost

Costs for the final lock extension plans are summarized in Table 15-4. A more detailed baseline cost estimate (to the sub-feature account level) is included in the Engineering Appendix (Document ED-2). The plan costs include extension of the Auxiliary lock to 1200 feet, with a supplementary filling culvert, and rehabilitation of the locks and the navigation dam (work items which are also part of the Without-Project condition).

TABLE 15-4.
Greenup Locks and Dam -- Summary of First Costs for Final Plans ¹
(millions of 1999 Dollars)

Item	First Cost
Near Term Project Costs	
New Lock Construction (2006-07)	
Lands and Damages	-
Relocations	0.6
Locks	135.2
Fish & Wildlife	3.6
Buildings, Grounds, & Utilities	0.8
Planning, Engineering & Design	18.8
Construction Management	9.4
Subtotal New Lock Construction	168.4
Miter Gate Quick Changeout (2008-16)	7.1
Subtotal 600' Extension Plan	175.5
Main Chamber Rehabilitation (2008-09) 2/	19.1
Subtotal Near Term Costs	194.6
Longer Term Project Costs	
Auxiliary Lock Rehabilitation (2030-31)	21.9
Dam Rehabilitation (2043-45)	24.8
Subtotal Long Term Costs	46.7
TOTAL LIFE CYCLE PROJECT COSTS	241.3

1/ Project costs shown in this table are all first costs expressed in October 1999 dollars, regardless of when the expenditure occurs.

2/ The Main chamber Rehabilitation also includes work on the Auxiliary chamber's emergency gates, as described in the Engineering Appendix (Document ED-2).

Investment Cost

Investment costs are the sum of construction expenditures and the accrued interest (interest during construction or IDC) on those expenditures up to the time the new lock extension is operational and the project begins producing benefits. Investment costs also include any major maintenance expenditures made during the economic life of the project. Such expenditures include component replacements, rehabilitations and installation of the MGQCO system under the with project plan. For these post online costs, the opposite of IDC is applied and the costs are discounted to the online date before amortizing. The earliest time that a lock extension project is estimated to be operational is 2008, thus 2008 serves as the base year for amortization. Investment costs for the final plan are displayed in **Table 15-5** below.

Annual Costs

The total annual costs for the final plans are the summation of the annualized capital costs and the estimated O&M cost. Annualized capital costs include interest and amortization charges on the investment cost and were computed using an interest rate of 6 7/8% and economic life of 50 years. The normal O&M costs are based on actual day to day operating expenses at Greenup as well as other locks and dam projects on the Ohio River. The O&M costs include cyclical maintenance, which are costs for repair and equipment replacement for the locks, but are not of the magnitude to be classified as major rehabilitation. Dredging costs for the lock approaches are the same for with and without conditions. A summary of annual costs is included in **Table 15-5**.

TABLE 15-5.
Greenup Locks and Dam
Summary of Investment and Annual Costs for Final Plan
(millions of 1999 Dollars, 6 5/8% Discount Rate, base year 2008)

Item	Without Project Condition	Final Plan (600' Extension)
INVESTMENT COSTS		
New Construction	-	168.4
Main Chamber Rehabilitation 1/	19.1	19.1
Auxiliary Chamber Rehabilitation	22.1	21.9
Dam Rehabilitation	24.8	24.8
Miter Gate Quick Changeout (2008-2016)	-	7.1
subtotal	66.0	241.3
IDC (new construction)	-	5.8
Discounting of post 2008 work	(30.1)	(36.6)
Total Investment Costs 2/	35.9	210.5
AVERAGE ANNUAL COSTS		
Capital Costs	2.5	14.5
O&M Cost		
Normal O&M	3.6	3.5
Helper boats	0.1	0.0
Cyclical Maintenance	1.0	1.1
Dredging	0.2	0.2
Transportation Cost Impacts	1.5	-
TOTAL AVERAGE ANNUAL COSTS 3/	8.9	19.4
INCREMENTAL AVERAGE ANNUAL COSTS	--NA--	10.5

1/ The Main chamber Rehabilitation also includes work on the Auxiliary chamber's emergency gates, as described in the Engineering Appendix (Document ED-2).

2/ Total investment costs include the project costs (see Table B-11-3) plus interest during construction charges.

3/ Total annual costs are the average annual discounted values of total investment costs (capital costs), O&M costs, and transportation impacts incurred throughout the life of the project.

Annual Benefits

Incremental average annual benefits attributable to the final plan come from two sources: 1)transportation savings and 2)construction employment impacts. The navigational benefits for the final plan represent the increase in total system transportation cost savings over the without project condition. Labor drawn from counties with substantial and persistent unemployment relative to the U.S. as a whole is accountable as a project benefit and is included in NED benefits estimates for the recommended plan. These construction employment impacts at Greenup amount to \$0.5 million on an average annual basis. A summary of the incremental annual benefits, incremental annual costs, net annual benefits, and benefit-cost ratios are presented in Table 15-6. A comprehensive analysis and comparison of the navigational, economic, and environmental aspects for the final plans is provided in Table 15-7.

TABLE 15-6.
Greenup Locks and Dam
Summary of Annual Benefits and Costs for Final Plans
(millions of 1999 dollars, 6 5/8% Discount Rate, base year 2008)

Item	Auxiliary Lock Extension
Incremental Annual Benefits ¹⁾	
Transportation Savings	26.0
Construction Impacts	0.5
Total Benefits	\$26.5
Incremental Annual Costs	\$10.5
Net Annual Benefits	\$16.0
Benefit Cost Ratio	2.5

1) Includes benefits for construction activities associated with the lock extension plan. (Refer to the Economics Appendix (Document EC) Attachment 6).

Sensitivity analyses were performed to test the above results against different traffic scenarios and various timing options. Details on these sensitivity analyses are presented in the Economics Appendix (Document EC). These analyses confirmed the value of completing improvements at Greenup L&D by year 2008, with the benefits shown in the Table above.

TABLE 15-7.
Ohio River Mainstem System / Greenup L&D
Summary Analysis of Final Plan (Sheet 1 of 4)

Item	Without-Project Condition	Auxiliary Lock Extension
1. Plan Description	Rehabilitate Main locks by 2009, Auxiliary lock by 2030 and rehabilitate dam by 2045.	Lengthen Auxiliary lock to 1200' including new culverts for filling and emptying system by 2008. Rehab Main lock by 2010, Aux. by 2030, and dam by 2045. Install quick gate changeout system (MGQCS).
2. Navigability	Main lock (110' x 1200') and Aux. lock (110' x 600') provide adequate capacity. Main lock not dependable because of age and condition. Auxiliary lock alone (as during Main closures) is not adequate.	Improved, lengthened Auxiliary lock provides adequate capacity when Main Lock is closed.
3. Performance Indicators: <i>a. Lock Capacity</i> <i>b. Lockage Policy</i> <i>c. Accommodated Traffic</i> <i>d. Average Delays</i>	158 Million tons annually Use of helper boats when Main chamber is closed. Reaches 100 mil tons by 2019 and grows to 148 million by 2060. All traffic served when Main lock is operational. Maximum annual delay of 102 (year 2051) hrs/tow during analysis period.	214 Million tons annually Single lockages for 1200' tows in both Main and Auxiliary locks. No helper boats required during closures. Reaches 151 million tons by 2060. All traffic demands met. Maximum annual delay of 13hrs/tow during analysis period.
4. Real Estate and Relocations	None required.	Use 166 acres of Federal land; no structures or relocation required.

TABLE 15-7. (continued)
Ohio River Mainstem System / Greenup L&D
Summary Analysis of Final Plan (Sheet 2 of 4)

Item	Without-Project Condition	Auxiliary Lock Extension
5. Economic Analysis <i>(millions of 1999\$ @ 6 5/8%)</i>		
a. Life Cycle Investment Cost		
-New Construction(2006-07)	0.0	168.4
-MGQCS	0.0	7.1
	<hr/>	<hr/>
-Subtotal, Authorization work	0.0	175.5
-Main Chamber Rehab(2008-09)	19.1	19.1
	<hr/>	<hr/>
-Subtotal, Near-Term Cost	19.1	194.6
-Dam Rehab(2043-45)	24.8	24.8
-Auxiliary Chamber Rehab(2030-31)	21.9	21.9
	<hr/>	<hr/>
-Subtotal, Long Term Cost	46.7	46.7
	<hr/>	<hr/>
-Total Life Cycle Project Cost	\$ 66.0	\$ 241.3
	<hr/>	<hr/>
-Interest During Construction	0.0	5.8
-Discounting post 2008 work	-30.1	-36.6
	<hr/>	<hr/>
Total Investment Costs	\$ 35.9	\$ 210.5
b. Annual Cost		
-Capital Cost	2.5	14.5
-Normal O&M Cost	3.6	3.5
-Helper Boat Costs	0.2	0
-Maintenance & Dredging	1.2	1.3
-Transportation Impacts	1.5	0
-Total Annual Costs	\$8.9	\$ 19.4
c. Incremental Annual Cost	N/A	\$10.5
d. Incremental Annual Benefits	N/A	\$26.5
e. Net Annual Benefits	N/A	\$16.0
f. Benefit-Cost Ratio	N/A	2.5

TABLE 15-7. (continued)
Ohio River Mainstem System / Greenup L&D
Summary Analysis of Final Plan (Sheet 3 of 4)

Item	Without-Project Condition	Auxiliary Lock Extension
6. Environmental Impacts		
<i>a. Wetland / Riparian</i>	Conditions are good; no change anticipated.	Nine acres of riparian habitat destroyed. Impacts fully mitigated.
<i>b. Aquatic Habitat</i>	Conditions are good. Slight negative impact from longer queues.	Negative impacts from lock wall demolition & excavation of river bed resulting in fish kills & loss of aquatic habitat. Impacts fully mitigated.
<i>c. Terrestrial Habitat</i>	No impacts.	Construction and disposal of fine material impacts 139 of forests and vegetated fields. Mitigation measures offset losses.
<i>d. Floodplains.... (below 100 yr flood)</i>	No impacts.	Disposal on fields will not impact 100-year flood level.
<i>e. Endangered Species</i>	No impacts.	None present
7. Cultural Resource Impacts	Slight negative impact due to continual human activity.	Four archaeological sites in potential disposal area. Plan includes either recovery or preservation of artifacts.
8. Social Impacts	No Impacts.	No Impacts.

TABLE 15-7. (continued)

**Ohio River Mainstem System / Greenup L&D
Summary Analysis of Final Plan (Sheet 4 of 4)**

Item	Without-Project Condition	Auxiliary Lock Extension
9. Plan Evaluation		
<i>a. Planning Objectives</i>		
- Ensure Future Navigability	Partially met. Delays significantly increase during Main lock closures.	Fully met.
- Improve Nav. Efficiently	Not met. Delays increase as Main lock closure become more frequent.	Fully met. No double lockages.
- Conserve FWL Resources	Longer queues in out-years could adversely impact mussel beds.	All onsite impacts fully mitigated.
<i>b. Addresses Industry Needs</i>	Not met.	Met.
<i>c. Industry Preference</i>	Second Choice	First Choice
<i>d. Evaluation Criteria</i>		
- Completeness	Yes	Yes
- Effectiveness	Least	Most
- Efficiency	Second	First
- Acceptability	Least	Most

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SECTION 16

COORDINATION and COMMENTS on DRAFT INTERIM REPORT

A draft "December 1999" version of this Interim Report (including Environmental Impact Statement) was distributed to 66 addressees in January 2000. The recipients included various state, Federal, and local agencies and transportation groups -- in partial fulfillment of requirements of the National Environmental Policy Act (NEPA). In addition, over 2500 copies of a "Notice of Availability [of the Draft Report and EIS]" were mailed in January 2000. The Notice is reproduced in the "Exhibits" section at the end of the Main Report. Following distribution of the Notice, copies of the report (either printed, or digital copies of the documents on CDROM-disk) were also distributed to the general public (on request). The digital versions of the documents were also available for download to Personal Computers via the Internet from the Louisville District Internet site.

Public meetings were held in Greenup, KY on February 9, 2000 and at Mt. Vernon, IN on February 14, 2000 to discuss the findings in the draft Interim. The meetings were announced in four ways:

- The two meetings were announced in the " " that was mailed out to 3000 addresses, including Federal, State, and local agencies and government officials; transportation groups; navigation interests; environmental groups that have been active in navigation issues; U.S. Senators and Congressmen; libraries and news media in the Ohio valley; individuals who have attended previous ORMSS affairs.
- The Louisville and Huntington District Public Affairs offices issued news releases to news media organizations in their respective Districts. (A copy of the Louisville District's news release is included in the "Exhibits" in this Main Report.)
- **Federal Register** Notice, dated January 14, 2000 (Volume 65, Number 10) [Page 2390-2391]. Marked as follows: ENVIRONMENTAL PROTECTION AGENCY [ER-FRL-6250-1] Environmental Impact Statements; Notice of Availability RESPONSIBLE AGENCY: Office of Federal Activities, General Information (202) 564-7167 or www.epa.gov/oeca/ofa. Weekly receipt of Environmental Impact Statements Filed January 03, 2000 Through January 07, 2000 Pursuant to 40 CFR 1506.9.
- Meeting information and the text of the "Notice of Availability" were available via computer on the Louisville District public Internet site.

Various comments and letters were received in response to the Draft report, the meetings, and the Notice of Availability. Oral and written comments received at the two public meetings and in letters received during January-February 2000, and the Corps' responses to these comments, are addressed in this final Interim Report and EIS (dated April 2000). Copies of the letters and the Corps' responses are reproduced in the attached Environmental Impact Statement.

Some pages in this Interim Report have been revised between February 2000 and April 2000 as a result of Corps review (corrections and clarifications), and / or to address particular issues raised in the comments and letters received per the previous paragraph.

Pages in the Main Report and in Appendices that have been revised during or as a result of the draft's coordination are generally marked "Revised April 2000" (or similarly) at the bottom of pages -- i.e., near the page number. (Changed pages in the EIS, however, were not explicitly marked due to the many revisions / clarifications that were made throughout the EIS).

CONCLUSIONS AND RECOMMENDATIONS

This Interim Report on improvements at J.T.Myers L&D and Greenup L&D on the Ohio River has been prepared as part of the ongoing Ohio River Mainstem Systems Study. The report shows benefits for providing similar improvements at each of these two lock sites – that is, to extend the 600-foot long Auxiliary lock chamber at each site to a 1200-foot length and installation of a Miter Gate Quick Changeout System (MGQCS). When completed, both Myers and Greenup L&Ds will then have two side-by-side 1200' long chambers. (These are nominal dimensions — a “1200-foot” chamber may actually be 1270' or longer from gate-to-gate. The dimensions indicate that a 1200'-long tow can be locked through in a single-cut operation.) The MGQCS provides for significantly faster repairs to the lock gates in the future at these two sites, whenever gate repairs are required.

These plans were discussed with state officials, shippers, marine-industry representatives, and U.S. Fish and Wildlife (USF&W) Service officials at various In-Progress Review meetings held quarterly during 1998-1999. Marine industry representatives and shippers in the Ohio Valley support the Lock Extension Plan. State and Federal fish and wildlife officials have been involved regularly and are integral members of the study's Environmental team. Environmental-mitigation components of the plans, while minor in nature, have been developed with the assistance of this integrated, inter-agency team. The USF&W Service's Draft Fish and Wildlife Coordination Act Report is attached herein to the Environmental Impact Statement.

A draft version of this Interim Report (including Environmental Impact Statement) was prepared in December 1999 and distributed to various state, Federal, and local agencies in January 2000, in partial fulfillment of requirements of the National Environmental Policy Act (NEPA). In addition, over 2500 copies of a "Notice of Availability [of the Draft Report and EIS]" were mailed in January 2000. Two public meetings were held in February 2000, and various written comments were received in response to the Draft report, the meetings, and the Notice of Availability. The comments, and the Corps' responses to these comments are addressed in this final Interim Report and EIS (dated April 2000).

Current traffic projections indicate that by the year 2010 tonnage at both projects will exceed the capacity of their respective Auxiliary chambers. Any closure of the Main chamber causes serious delay costs for the towing industry. Maintenance of the Main chamber requires periodic, lengthy closures, as does the replacement of worn-out major lock components. Near term reliability concerns at Greenup will be addressed with a Major Rehabilitation of the Main chamber, while at J.T. Myers major components will be replaced individually. Each of these events will require that all traffic use the projects' small Auxiliary chambers. For Greenup L&D, pertinent details regarding the justification of the Major Rehabilitation are contained in this Interim Report; therefore, it is concluded that this report concurrently satisfies all reporting requirements for the Greenup Locks' Major Rehabilitation.

The discussions below provide specific recommendations for each of the two lock sites:

J.T. MYERS L&D

As shown in Table 11-3, the Auxiliary Lock Extension Plan for J.T. Myers L&D is the National Economic Development (N.E.D.) plan, given that it has the highest net benefits. Per Table 12-6, this plan has net annual benefits of \$8.6 million annually (incremental to the Without-Project plan) over the analysis period, yielding a benefit-to-cost ratio of 1.8 to 1.

As shown in Table 12-7, the Auxiliary Lock Extension Plan meets all the Plan Formulation objectives, addresses the needs of waterborne freight shippers and the marine industry, yet results in very minimal negative impacts to the environment.

It is, therefore, recommended that navigation improvements be made at J.T. Myers L&D -- namely extension of the Auxiliary chamber to a nominal length of 1200' and installation of the Miter Gate Quick Changeout System, and that these improvements be authorized by Congress for implementation as a Federal project together with such modifications as, at the discretion of the Chief of Engineers, may be advisable. For the J.T. Myers project site, first cost of construction is \$181.7 million. If authorized by Congress, all future design and construction costs would be shared 50/50 between the U.S. Government and the Inland Waterway Users' Trust Fund (this fund is maintained through a waterway diesel fuel tax).

GREENUP L&D

As shown in Table 14-3, the Auxiliary Lock Extension Plan for Greenup L&D is the National Economic Development (N.E.D.) plan, given that it has the highest net benefits. Per Table 15-6, this plan has net annual benefits of \$16.0 million annually (incremental to the Without-Project plan) over the analysis period, yielding a benefit-to-cost ratio of 2.5 to 1.

As shown in Table 15-7, the Lock Extension Plan meets all the Plan Formulation objectives, addresses the needs of waterborne freight shippers and the marine industry, yet results in very minimal negative impacts to the environment.

It is, therefore, recommended that navigation improvements be made at Greenup L&D -- namely extension of the Auxiliary chamber to a nominal length of 1200' and installation of the Miter Gate Quick Changeout System, and that these improvements be authorized by Congress for implementation as a Federal project together with such modifications as, at the discretion of the Chief of Engineers, may be advisable. For the Greenup project site, first cost of construction is \$175.5 million. If authorized by Congress, all future design and construction costs would be shared 50/50 between the U.S. Government and the Inland Waterway Users' Trust Fund (this fund is maintained through a waterway diesel fuel tax).

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LIST OF EXHIBITS

0. U.S. Army Corps of Engineers, Huntington, Louisville, and Pittsburgh Districts, Public Notice: "Ohio River Main Stem Systems Study, Public and Agency Scoping Meetings", dated October 30, 1998.
1. Albert Surmont, Fishery Biologist, Kentucky Dept. of Fish & Wildlife Resources, letter of Nov. 30, 1998, following Public Scoping meeting of Nov. 19, 1998.
2. Robert M. Morton, The Wildlife Society, Kentucky Chapter, letter of Dec. 7, 1998, following Public Scoping meeting of Nov. 17, 1998.
3. U.S. Fish and Wildlife Service, Cookeville, TN, letter of Dec. 14, 1998, in response to the "Notice of Intent to Prepare an Environmental Impact Statement for the Ohio River Mainstem System Study."
4. Lewis Kornman, District Fisheries Biologist, Kentucky Dept. of Fish & Wildlife Resources, letter of Dec. 15, 1998, following Public Scoping meeting of Nov. 19, 1998.
5. Hoosier Environmental Council (HEC), letter of Dec. 24, 1998.
6. U.S. Fish and Wildlife Service, Bloomington, IN, letter of March 10, 1999, in response to the multi-agency meetings of January 7 and February 17, concerning improvements at Myers L&D.
7. Director, Indiana Dept. of Natural Resources, letter of April 7, 1999, following field-site meeting at Myers on 17 February 1999 and other meetings; and various Enclosures.
8. Director, Indiana Dept. of Natural Resources, letter of Nov. 3, 1999, following receipt of a Draft US F&W Coordination Act Report on Interim Projects at Greenup L&D and John T. Myers L&D.
9. The Honorable Bob Taft, Governor, State of Ohio, letter of December 7, 1999.
10. The Honorable Paul E. Patton, Governor, Commonwealth of Kentucky, letter of December 8, 1999.
11. The Honorable Frank O'Bannon, Governor, State of Indiana, letter of December 10, 1999.
12. Notice of Availability, mailed from Louisville District, January 2000.
13. February 7, 2000 news release from Louisville District announcing February 14, 2000 Public Meeting at Mt. Vernon, IN.
14. Sign-In Sheet from Public Meeting, Mt. Vernon, IN, February 14, 2000.